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GUIDE TO CHEMICAL WEED CONTROL

Ministry of Agriculture and Food
ONTARIO
Jack Riddell, Minister
Clay Switzer, Deputy

GENERAL INFORMATION
NOTES ON CHEMICALS
EQUIPMENT
FIELD CROPS
HORTICULTURAL CROPS
ROADSIDES AND NON-CROP AREAS

87· 04755/

AGDEX 641

To the best of the collective knowledge of the members of the Ontario Weed Committee, all pesticides listed in this publication were federally registered, reviewed by the Ontario Pesticides Advisory Committee and classified by the Ministry of the Environment as of November 6, 1986.

The information presented on the pesticide container label regarding application rates and methods of application are the final authority and where conflicts occur between this publication and the container label, the latter applies.

PAY CLOSE ATTENTION TO ALL INSTRUCTIONS AND WARNINGS PRINTED ON THE PESTICIDE LABEL.

The Ministry of Agriculture and Food, or the Ontario Weed Committee by printing this publication does not offer any warranty or guarantee and they do not assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

POLICY STATEMENT

Weather and other factors influence the effectiveness of pesticides and the likelihood of plant injury by control chemicals. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powders (WP or SP) generally are less likely to cause plant injury than liquid concentrates (EC, SC, and F).

A number of brand names of pesticides are given in the calendars as a convenience to the grower and are neither an endorsement of the product nor a suggestion that similar products are not effective.

The pesticide recommendations are reviewed annually by the Ontario Weed Committee. **OLD EDITIONS SHOULD BE DISCARDED.**

For additional information or clarification of recommendations, contact Ontario Ministry of Agriculture and Food personnel listed on page 168.

FEDERAL REGISTRATION AND PROVINCIAL CLASSIFICATION

Ontario's Pesticides Act and Regulation 751, administered by the Ministry of the Environment, prohibits the sale and use of pesticide products unless they are registered under the federal Pest Control Products Act and classified under the provincial Pesticides Act by being placed in one of six schedules of the Ontario regulation.

FEDERAL REGISTRATION

There are three categories:

1. *Full Registration*
   Implies that all federal departments involved in the registration process agreed that the data package was acceptable at time of registration.
2. *Temporary Registration*
   Indicates that there is a need for additional scientific or technical information to acquire a full registration. Temporary registrations expire on the 31st of December each year and the products must be re-registered if they are to be available for use in the following year.
3. *Temporary Registration (Restricted Class)*
   Indicates that there is an urgent need for the pesticide but that studies on the safety of the product are incomplete. Such registrations expire on the 31st of December each year and the products must be re-registered if they are to be available for use the following year. The pesticide product presently carrying a temporary registration (restricted class) and classified for use in Ontario is: Goal (oxyfluorfen). This material may, or may not, be available for use in 1987.

PROVINCIAL CLASSIFICATION

Pesticide products are classified into six schedules in Regulation 751 on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration and usage. This classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario.

A procedure has recently been put in place to upgrade the classification process for pesticide products. This procedure provides for "interim status" products. These products are proposed by the Minister for inclusion in a schedule to Regulation 751, and the proposal is published in the *Ontario Gazette*. A person who sells or uses such a product as if it were in the specified schedule, is exempt from the prohibition against sale or use of an unscheduled product.

For updated information on the regulatory status of these or other pesticides contact the Agriculture & Industrial Chemicals Section, Hazardous Contaminants & Standards Coordination Branch, Ministry of the Environment, Toronto Telephone (416) 965-2401.

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Prepared by
MEMBERS OF THE ONTARIO WEED COMMITTEE

Ontario Agricultural College, University of Guelph
J.F. Alex, G.W. Anderson, N.P. Cain, J.C. Hall, V. Souza Machado, G.R. Stephenson, C.J. Swanton, R.A. Upfold

Agriculture Canada
F.Y. Chang, M. Stewart, Ottawa; A.S. Hamill S.E. Weaver, Harrow; N. Smits, Smithfield; B.F. Zilkey, Delhi

Crop Protection Institute of Canada
L.M. Murray and A.G. McFadden

Ontario Hydro
B.M. Allen, Toronto

Ontario Ministry of the Environment
A.R. Chisholm, D.J. Mewett D. MacKenzie

Ontario Ministry of Natural Resources
R.A. Campbell, Maple

Ontario Ministry of Transportation and Communications
A.J. Stripnieks, Toronto

Ontario Ministry of Agriculture and Food, Plant Industry Branch
H. Plas, Simcoe; L. Huffman, Harrow; H.C. Wright, R.D. McLaren, (Secretary), Guelph

Colleges of Agricultural Technology
R.H. Brown, (Chairman and Editor), J.E. Shaw, Ridgetown; D.W. MacDonald, Kemptville; A.V. Skepasts, New Liskeard; J. O'Toole, Centralia

Horticultural Research Institute of Ontario
J. O'Sullivan, Simcoe

Agricultural Laboratory Services
R. Frank, Guelph

Ontario Soil & Crop Improvement Association
J. Yungblut, R.R. #1, Fonthill; J. McGregor, R.R. #1 Braeside

Your 1987 **GUIDE TO CHEMICAL WEED CONTROL** outlines the latest recommendations for the control of weeds by use of herbicides. Where these recommendations relate to the control of weeds in a particular crop they may be quite specific, and must be followed closely if control is to be obtained and damage to the crop avoided. Cultural, seeding and other operations may have to be adjusted to the spraying program for maximum effectiveness.

WEED CONTROL GLOSSARY

(Also see Notes on Chemicals)

ACID (2,4-D, glyphosate) — the active part of the product being used — usually indicated in grams per L on the label.

ACTIVE INGREDIENT — the chemical compound in a product that is responsible for the herbicide effects.

ADJUVANT — an ingredient added to a spray mixture to aid or modify the action of the herbicide, or to alter the physical characteristics of the mixture.

AMINE — a formulation of chemical which is relatively non-volatile under most climatic conditions.

BAND TREATMENT — a herbicide applied as a narrow strip over the crop row, usually followed by inter-row cultivation.

COMPATIBLE — compounds or formulations that can be mixed and applied together without undesirably altering their separate effects.

CONTACT CHEMICALS — chemicals which kill only the parts of the plant on which they are sprayed.

DIRECTED TREATMENT — a treatment directed onto the weeds or soil in such a manner as to avoid contact with the crop.

DORMANT — a resting stage similar to the condition of a plant during the winter.

EMERGENCE — the time at which the seedling first appears above the ground.

ESCAPE — a plant in a treated area that has been missed or survived the treatment.

ESTER — type of formulation of a chemical.

FORMULATION — means the same as PRODUCT — an active ingredient processed with other materials to make it usable, or, the type of herbicide commercially available, such as amine, low-volatile ester or sodium salt of 2,4-D.

HERBICIDE — a chemical which is used to kill or inhibit weeds.

HORMONE-TYPE HERBICIDE — includes 2,4-D, 2,4-DB, mecoprop, MCPA, MCPB, dichlorprop, dicamba, TBA, picloram.

LOW-VOLATILE ESTER — a formulation of chemical which, after application and under certain climatic conditions, may cause damage to sensitive crops and landscape plants by vapor activity.

NONSELECTIVE HERBICIDE — a chemical used in such a manner that all vegetation both weed and crop — is damaged.

PERENNIAL — a plant that lives for more than 2 years.

PRODUCT — the contents of a herbicide container as marketed. It contains the active ingredient and other solvents, surfactants or carriers that are referred to as inert ingredients.

PROGRAM — application of one or more herbicides at two different stages of crop and/or weed growth. The second herbicide application is used to provide control of the weeds either escaping the original herbicide treatment or which are problems at different periods in the growth of the crop.

RESISTANT — a crop not damaged by a herbicide if applied as recommended, or a weed not controlled by any practical rate of herbicide.

SELECTIVE HERBICIDE — a chemical used in such a manner that it will kill weeds on a growing crop without damaging the crop.

SODIUM SALT — type of formulation of a chemical

SOIL STERILANT — a nonselective chemical that acts through the soil to prevent the growth of plants.

SURFACTANT — an ingredient in or added to the herbicide formulation to improve the dispersing, spreading, sticking, or wetting properties of the spray mixture.

SUSCEPTIBLE — a crop that may be damaged — or a weed that may be controlled readily by a recommended rate of herbicide.

TANK-MIX — two chemicals that are purchased separately and mixed in the sprayer tank — as opposed to a mixture formulated by the manufacturer (Kil-Mor, Amizine).

TRANSLOCATED HERBICIDE — a chemical (herbicide) that moves within the plant.

THE USE OF CHEMICALS TO CONTROL WEEDS

Chemicals may be used for the control of weeds either **selectively** in crops or **nonselectively** for the control of perennial weeds or on land not in crops, such as roadsides, fencerows and areas difficult to cultivate.

The treatments listed in this publication are based on extensive field and observation on farms. **Herbicides should not be used in cold frames or greenhouses unless specifically recommended.**

The grower should not rely on only one chemical or practice over a period of years. For example, 2,4-D controls most broadleaf annual weeds but it does not kill grasses. When the broadleaf weeds have been killed, the weeds not controlled can become a serious problem. The use of ATRAZINE in a continuous corn program may not provide adequate control of late germinating annual grasses. These weeds may be controlled by the use of some other herbicide, or by a change in the method of using the desired herbicide.

Time of Herbicide Treatment in Crop Areas

The susceptibility of both crops and weeds to herbicides is related to the time of application. Therefore, it is important to use the chemical at a time when the crop is at its maximum resistance and the weeds are at their maximum susceptibility. This time will vary depending on the crop involved and the herbicide being used. Different terms of describing the times at which herbicides may be applied have come into general use. Unless specified differently, these times refer to the stage of development of the crop plants.

PREPLANTING TREATMENTS — Preplanting treatments are applied before the crop area is sown or planted. Some herbicides used in this way act on germinating seedlings, other may also kill weed seeds. Most herbicides when used preplanting must be throughly incorporated with the soil soon after application. Directions for incorporation are given throughout the publication where these materials are recommended.

PREEMERGENCE TREATMENTS — Chemicals used in preemergence treatments are applied after seeding but before the specified weed or crop emerges. The chemicals may control weeds by (1) killing weed seedlings and/or (2) establishing a toxic layer of chemical on or near the soil surface in which germinating seeds and young seedlings cannot survive.

For successful preemergence treatments the crops must either be tolerant of the chemical at the seedling state or the toxicity must have disappeared before the crop emerges.

A smooth, well-prepared seedbed which is free of clods is necessary for best results. The surface soil should also be moist and the temperature favorable for the rapid germination of weed seeds.

POSTEMERGENCE TREATMENTS — Postemergence treatments are applied after the crop and weeds have emerged. A selective chemical is used and the weeds are killed with little damage to the desirable plants. The types of weeds that may be controlled depend on (1) the susceptibility of the weed, and (2) the tolerance of the crop to the chemical. Treatment at the correct stage of crop development is important. Since most weeds are more susceptible to chemicals when young, early treatments will require less herbicide and will result in less damage to crops from weed competition and from spray equipment.

Sometimes a herbicide may be applied postemergence to the crop but preemergence to the weeds. For example, a crop may be cultivated, then a herbicide applied to the weedfree soil to control subsequent germinating weeds.

Chemical Weed Control in Non-Crop Areas

TREATMENT WITH "SOIL STERILANTS" — Perennial weeds may be killed and the growth of annual weeds prevented by the use of soil active chemicals which are toxic to most plants. These "soil sterilants" may be applied at any time. Best results are obtained if application is followed by a period of rainfall.

TREATMENT WITH TRANSLOCATED CHEMICALS — In eliminating perennial weeds, heavier dosages of 2,4-D and of other translocated chemicals than would normally be used in cropland must be applied. Mixtures of 2,4-D with other chemicals may be used to keep areas free from vegetation.

TREATMENT WITH CONTACT CHEMICALS — These chemicals are not selective but kill all foliage they contact. While this will kill annual weeds, regrowth usually develops from the roots or crowns of perennial plants.

APPLYING HERBICIDES

An exterminator's license may be required by a person applying herbicides on property other than his own domestic property. An operator's licence is required by a person operating an extermination business. **For further information,** contact any Ministry of the Environment Regional Office or the Ministry of the Environment Agricultural and Industrial Chemicals Section, 135 St. Clair Avenue West, Toronto, M4V 1P5.

Successful chemical weed control requires the application of the correct quantity of herbicide uniformly over the area. With selective weed control in field crops, this application becomes a precision operation with reliable equipment.

The chemical is applied as an emulsion, solution, or suspension. The volume of the mixture used per hectare depends on the herbicide and the crop being treated. Generally low volumes 50 to 200 L per hectare are used when 2,4-D chemicals are sprayed on emerged weeds, and higher volumes (150 to 300 L per hectare) when preemergence herbicides are applied.

Small areas may be treated with a garden sprayer, or even with a watering can, if care is taken to wet all foliage.

Power equipment is necessary for larger areas. Equipment used for applying 2,4-D-like chemicals should not be used later for applying other solutions to 2,4-D-susceptible crops or garden plants.

The possibility of damage to nearby crops or plants from herbicide drift is increased by the use of high pressure, small nozzle tips, herbicide dusts or mists. Every precaution should be taken to ensure that no drift occurs from the treated areas.

The application of herbicides by mist or air-blast sprayers in agricultural areas of Ontario is NOT recommended.

Application of herbicides by aircraft may be feasible, particularly where large areas of a crop are grown in a solid block. Because of the potential for increased drift when aerial application is practised, it is necessary to use every precaution. Such precautions include spraying at a time of day (early morning or evening) when drift due to wind is more apt to be minimal. It may be wise to prespray areas near susceptible crops or trees with ground equipment, thus leaving the larger open areas for aerial application.

In general, aerial application of hormone-type herbicides such as 2,4-D is NOT recommended in agricultural areas where susceptible crops may be damaged. It is recognized, however, that some hormone-type herbicides are being applied by aircraft in certain areas such as on cereal crops grown where no susceptible crops, trees, gardens, etc., will be affected.

Aerial applicators must be licensed by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the Pesticides Act for the aerial application of Schedules 1 and 5 herbicides, Schedule 2 hormone-type herbicides, and paraquat. The area to be sprayed must be inspected by Ministry personnel to ensure that spraying can be done without injury to susceptible crops.

HERBICIDE DRIFT

Vapor drift is the movement of fine particles from a herbicide that tends to give off vapor at the time of or after application. Vapors will increase as temperature rises. Vaporization reduces the effect of the herbicide application and increases the danger to nearby susceptible crops.

Spray drift is the windborne movement of fine spray particles away from the intended target areas. Drift will occur any time that the wind is strong enough to carry the particles. Damage caused by drift will depend on how much herbicide escapes and on the susceptibility of the crop or plants that it reaches. High pressure, small nozzles and wind will increase the danger of drift. Lower pressures, larger nozzles, a larger volume of water and spraying only when wind speeds are low will decrease the danger.

Handy Metrics Conversion Factor

Litres per hectare x 0.4 = litres per acre
Kilograms per hectare x 0.4 = kilograms per acre

TABLE 1. HERBICIDES USED IN ONTARIO

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
AATREX	atrazine	Su	480 g/L	2.1	2
		WP	90	1.1	2
AATREX-NINE-O	atrazine	WG	90	1.1	2
AATREX-PLUS	atrazine + oil	Su	400 g/L	2.5	2
AFESIN	monolinuron	EC	200 g/L	5.0	3
AFOLAN F	linuron	Su	450 g/L	2.2	3
AGRICULTURAL WEED KILLER NO. 1	mineral oil herbicidal	Li	100	1.0	6
ALANAP	naptalam, NPA	Sn	240 g/L	4.2	3
allidochlor	CDAA, RANDOX	EC	480 g/L	2.1	1
		Gr	20	5.0	1
AMIBEN	chloramben	Gr	10	10.0	3
		Sn	240 g/L	4.2	3
AMIBEN DS	chloramben	SG	75	1.33	3
amino triazole	AMIZOL, amitrole	SP	50	2.0	3
		SP	90	1.1	3
		Sn	240 g/L	4.2	3
amitrole	AMITROLE-T, amitrole-t	Sn	240 g/L	4.2	3
		PS	1	—	3
amitrole	amino triazole, AMIZOL	See above			—
amitrole/simazine	AMIZINE	Em	(1 to 2) 25.5	3.9	3
		WP	(1 to 3) 60	1.7	2
	VEGETATION KILLER	Su	(1 to 4) 50 g/L	20.0	3
AMITROLE-T	amitrole-t	See above			—
AMIZINE	amitrole/simazine	Em	(1 to 2) 25.5	3.9	3
		WP	(1 to 3) 60	1.7	2
AMIZOL	amitrole	See above			3
ammonium sulfamate	Poison-Ivy & Brush Killer	Sn	500 g/L	2.0	3
AQUA-KLEEN	2,4-D	Gr	20	5.0	2
ATRA-MIX	atrazine + oil	Su	400 g/L	2.5	2
atrazine	AATREX-NINE-O	WG	90	1.1	2
	AATREX	Su	480 g/L	2.1	2
	ATRAZINE	WP	90	1.1	2
	ATRAZINE	WP	80	1.25	2
	ATRAZINE-FLOWABLE	Su	470 g/L	2.1	2
	ATRAZINE 50 L	Su	500 g/L	2.0	2
	ATRAZINE 4.8 L	Su	480 g/L	2.1	2
	PRIMATOL	Su	480 g/L	2.1	2
	PRIMATOL-NINE-O	SG	90	1.1	2
	VECTAL	WP	80	1.25	2
	VECTAL FLOWABLE	Su	500 g/L	2.0	2

HOW TO USE THE CONVERSION FACTOR

Multiply recommendation of amount of active ingredient in text by the conversion factor to get the amount of product to use.

Example **Dry materials** To apply 1.1 kg/ha linuron to control annual weeds in carrots
LOROX WP (50% active) 1.1 × 2 = 2.2 kg/ha (product)

Liquid or flowable To apply 2.25 kg/ha atrazine to control seedling weeds in corn
ATRAZINE 50 L (500 g/L active)
2.25 × 2 = 4.50 L/ha (product)

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
atrazine + oil	ATRA-MIX, AATREX-PLUS, AATREX-PLUS FLOWABLE	Su	400 g/L	2.5	2
atrazine/simazine	EKKO	WP	(1 to 1) 80	1.25	2
AVADEX BW	triallate	EC	400 g/L	2.5	2
		Gr	10	10.0	2
AVENGE 200C	difenzoquat	Sn	200 g/L	5.0	3
BANVEL 480	dicamba	Sn	480 g/L	2.1	2
BANVEL LH	dicamba	Sn	400 g/L	2.5	2
BASAGRAN	bentazon	Sn	480 g/L	2.1	3
BASAMID	dazomet	Gr	98	1.02	2
BASFAPON	dalapon	SP	74	1.35	3
bensulide	BETASAN, PREFAR, PRE-SAN	EC	480 g/L	2.1	3
	BETASAN	Gr	12.5	8.0	3
bentazon	BASAGRAN	Sn	480 g/L	2.1	3
bentazon/atrazine	LADDOK	Sn	(1 to 1) 400 g/L	2.5	2
BETASAN	bensulide	EC	480 g/L	2.1	3
		Gr	12.5	8.0	3
BLADEX	cyanazine	WP	80	1.25	2
		Su	480 g/L	2.1	2
BLAGAL	cyanazine/MCPA	Sn	(1 to 2) 375 g/L	2.7	2
BLAZINE	cyanazine/atrazine	WP	(2 to 1) 80	1.25	2
		Su	(2 to 1) 480 g/L	2.1	2
bromacil	HYVAR X	WP	80	1.25	2
	HYVAR X-L	Sn	240 g/L	4.2	2
bromacil/2,4-D	CALMIX PELLETS	PE	3 + 5	12.5	3
bromacil/diuron	KROVAR	WP	(1 to 1) 80	1.25	2
BROMOX 450M	bromoxynil/MCPA	EC	(1 to 1) 450 g/L	2.2	2
BROMOX 720M	bromoxynil/MCPA	EC	(1 to 1) 720 g/L	1.4	2
BROMOX C-100	bromoxynil	EC	450 g/L	2.2	2
bromoxynil	BROMOX C-100	EC	450 g/L	2.2	2
	PARDNER	EC	280 g/L	3.6	2
	TORCH	EC	225 g/L	4.4	2
	TORCH DS	EC	450 g/L	2.2	2
bromoxynil/MCPA	BROMOX 450M	EC	(1 to 1) 450 g/L	2.2	2
	BROMOX 720M	EC	(1 to 1) 720 g/L	1.4	2
	BUCTRIL M	EC	(1 to 1) 560 g/L	1.8	2
	SABRE	EC	(1 o 1) 720 g/L	1.4	2
BUCTRIL M	bromoxynil + MCPA	EC	(1 to 1) 560 g/L	1.8	2
butylate/antidote	SUTAN +	Gr	10	10.0	3
	SUTAN +	EC	800 g/L	1.25	3
butylate/atrazine	SUTAN + ATRAZINE	Gr	(3 to 1) 24	4.2	2
	SUTAZINE +	EM	(4 to 1) 720 g/L	1.4	2
CALMIX PELLETS	bromacil/2,4-D	PE	3 + 5	12.5	3
CASORON	dichlobenil	Gr	4	25.0	3
CDAA	allidochlor, RANDOX	EC	480 g/L	2.1	1
		Gr	20	5.0	1
chloramben	AMIDEN	Sn	240 g/L	4.2	3
		Gr	10	10.0	3
	AMIBEN DS	SG	75	1.33	3
	ORNAMENTAL WEEDER	Gr	4	25.0	3
	GARDEN WEEDER	Gr	1.2	83.0	3
	GARDEN WEED PREVENTER	Gr	4	25.0	3

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
chloroxuron	TENORAN	WP	50	2.0	3
chlorpropham	CIPC	EC	480 g/L	2.1	2
		Gr	20	5.0	2
		Gr	10	10.0	2
chlorulfuron	GLEAN	DF	75	1.33	2
chlorthal dimethyl	DACTHAL, DCPA	Gr	2.3	43.5	3
		Gr	5	20.0	3
		WP	75	1.33	3
CIPC	chlorpropham	EC	480 g/L	2.1	2
		Gr	10	10.0	2
		Gr	20	5.0	2
COBUTOX	2,4-DB	EC	400 g/L	2.5	2
COMPITOX	mecoprop	Sn	150 g/L	6.7	3
COMPITOX PLUS	mecoprop + 2,4-D	Sn	(1 to 1) 200 g/L	5.0	3
CUTRINE PLUS	copper compound	Sn	9	11.1	2
		Gr	3.7	11.1	2
		Sn	130 g/L	7.7	2
cyanazine	BLADEX	WP	80	1.25	2
		Su	480 g/L	2.1	2
cyanazine/atrazine	BLAZINE	WP	(2 to 1) 80	1.25	2
		Su	(2 to 1) 480 g/L	2.1	2
cyanazine/MCPA	BLAGAL	Sn	(1 to 2) 375 g/L	2.7	2
cycloate	RO-NEET	Gr	10	10.0	3
		EC	720 g/L	1.4	3
DACTHAL	DCPA, chlorthal dimethyl	Gr	2.3	43.5	3
		Gr	5	20.0	3
		WP	75	1.33	3
dalapon	DOWPON M, BASFAPON, DALAPON	SP	74	1.35	3
DALAPON Quack Grass Killer	dalapon	SP	25	4.0	3
dazomet	SOIL KARE (MYLONE)	Gr	50	2.0	2
dazomet	BASAMID	Gr	98	1.02	2
DCPA	chlorthal dimethyl, DACTHAL	Gr	2.3	43.5	3
		Gr	5	20.0	3
		WP	75	1.33	3
DESORMONE	2,4-D/dichlorprop	EC	480 g/L	2.1	2
		EC	700 g/L	1.4	2
dicamba	BANVEL	Sn	480 g/L	2.1	2
	BANVEL LH	Sn	400 g/L	2.5	2
	DYCLEER	Sn	400 g/L	2.5	2
	DYCLEER	Sn	480 g/L	2.1	2
dicamba/atrazine	MARKSMAN	FL	(1 to 2) 388 g/L	2.5	2
dicamba/2,4-D	DYCLEER 24	Sn	(1 to 2) 600 g/L	1.7	2
dicamba/MCPA	DyVEL	Sn	(1 to 4) 420 g/L	2.4	2
dicamba/MCPA/ mecoprop	TARGET	Sn	400 g/L	2.5	3
dichlobenil	CASORON	Gr	4	25.0	3
2,4-D	2,4-dichlorophenoxyacetic acid	EC			2
		Sn	Assorted		3
		PS			4
		Gr			2
2,4-D/dichlorprop	DESORMONE	EC	480 g/L	2.1	2
	DESORMONE	EC	700 g/L	1.4	2
	DIPHENOPROP, ISOPROP, PROPATURF, SILVAPROP	EC	700 g/L	1.4	2
	ESTAPROP	EC	600 g/L	1.7	2

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
2,4-D/mecoprop	MECOTURF PLUS 2,4-D	Sn	(1 to 1) 400 g/L	2.5	3
	COMPITOX PLUS	Sn	(1 to 1) 200 g/L	5.0	3
	PREMIUM LAWN WEEDKILLER	Sn	(1 to 1) 250 g/L	4.0	3
2,4-D/mecoprop/ dicamba	KILLEX	Gr, Sn, PS			3
	KIL-MOR	Sn	485 g/L	2.05	3
2,4-DB	EMBUTOX E	EC	400 g/L	2.5	2
	COBUTOX	EC	400 g/L	2.5	2
	2,4-D BUTYRIC	EC	400 g/L	2.5	2
	EMBUTOX 625	EC	625 g/L	1.6	2
dichlorprop mixtures	See 2,4-D/dichlorprop (above)				—
diclofop-methyl	HOE-GRASS 284	EC	284 g/L	3.5	3
difenzoquat	AVENGE 200C	Sn	200 g/L	5.0	3
DINITRO	dinoseb	see below			—
dinoseb	AMINE DINITRO	Sn	360 g/L	2.8	2
	DINITRO	EC	600 g/L	1.7	2
diphenamid	ENIDE	WP	50	2.0	3
DIPHENOPROP	2,4-D/dichlorprop	EC	700 g/L	1.4	2
diquat	REGLONE	Sn	200 g/L	5.0	3
	REGLONE A	Sn	200 g/L	5.0	2
diuron	KARMEX	WP	80	1.25	2
DNBP	dinoseb	See dinitro			—
DOWPON M	dalapon	SP	74	1.35	3
DUAL	metolachlor	EC	960 g/L	1.05	2
DYANAP	naptalam/dinoseb	Sn	(2 to 1) 360 g/L	2.8	2
DYCLEER	dicamba	Sn	400 g/L	2.5	2
DYCLEER	dicamba	Sn	480 g/L	2.1	2
DYCLEER 24	dicamba/2,4-D	Sn	(1 to 2) 600 g/L	1.7	2
DyVEL	dicamba/MCPA	Sn	(1 to 4) 420 g/L	2.4	2
EKKO	atrazine/simazine	WP	(1 to 1) 80	1.25	2
EMBUTOX E	2,4-DB	EC	400 g/L	2.5	2
EMBUTOX 625	2,4-DB	EC	625 g/L	1.6	2
ENIDE	diphenamid	WP	50	2.0	3
EPTAM	EPTC	EC	800 g/L	1.25	3
		Gr	2.3	43.5	3
		Gr	5	20.0	3
		Gr	10	10.0	3
EPTC	EPTAM	See above			—
EPTC/antidote	ERADICANE	See below			—
ERADICANE	EPTC/antidote	EC	800 g/L	1.25	3
ESSO WEED KILLER 350	mineral oil herbicidal	Li	100	1.0	6
ESTAPROP	2,4-D/dichlorprop	EC	(1 to 1) 600 g/L	1.7	2
flamprop-methyl	MATAVEN	EC	150 g/L	6.7	2
fosamine ammonium	KRENITE	Sn	480 g/L	2.1	3
GALEX 500	metolachlor/metobromuron	EC	300 g + 200 g/L	2.0	2
GARDEN WEED PREVENTER	chloramben	Gr	4	25.0	3
GESAGARD	prometryne	WP	80	1.25	2
GLEAN	chlorsulfuron	DF	75	1.33	2
glyphosate	ROUNDUP	Sn	356 g/L	2.8	3
GOAL	oxyfluorfen	EC	192 g/L	5.2	1
GRAMOXONE	paraquat	Sn	200 g/L	5.0	2

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
HERBEC 20 P	tebuthiuron	PE	20	5.0	2
hexazinone	VELPAR	SP	90	1.1	2
HOE-GRASS 284	diclofop-methyl	EC	284 g/L	3.5	3
HYVAR X	bromacil	WP	80	1.25	2
HYVAR X-L	bromacil	Sn	240 g/L	4.2	2
KARMEX	diuron	WP	80	1.25	2
KERB	propyzamide	WP	50	2.0	3
KILLEX	2,4-D/mecoprop/dicamba	Gr, Sn, PS	Assorted		3
KIL-MOR	2,4-D/mecoprop/dicamba	SN	485 g/L	2.05	3
KRENITE	fosamine ammonium	Sn	480 g/L	2.1	3
KROVAR	bromacil/diuron	WP	(1 to 1) 80	1.25	2
LADDOK	bentazon/atrazine	Sn	(1 to 1) 400 g/L	2.5	2
LEXONE	metribuzin	WP	50	2.0	2
LEXONE DF	metribuzin	WG	75	1.33	2
LEXONE L	metribuzin	Sn	480 g/L	2.1	2
linuron	LOROX	WP	50	2.0	3
	AFOLAN F	Su	450 g/L	2.2	3
LOROX	linuron	WP	50	2.0	3
LOROX L	linuron	Su	480 g/L	2.1	3
maleic hydrazide	ROYAL MH 60 SG	SG	60	1.7	3
MARKSMAN	dicamba/atrazine	FL	(1 to 2) 388 g/L	2.5	2
MATAVEN	flamprop-methyl	EC	150 g/L	6.7	2
MCPA	METHOXONE, MCPA-sodium salt,	Sn			3
	MCPA amine	Sn	Assorted		3
MCPB	TROPOTOX	Sn	400 g/L	2.5	3
MCPP	mecoprop	Sn	See below		—
mecoprop	MCPP, MECOTURF, COMPITOX	Sn	Assorted		3
MECOTURF	mecoprop	Sn	150 g/L	6.7	3
MECOTURF + 2,4-D	mecoprop/2,4-D	Sn	(1 to 1) 400 g/L	2.5	3
metam-sodium	VAPAM	Sn	380 g/L	2.6	3
METHOXONE	MCPA	Sn	500 g/L	2.0	3
methyl promide + chloropicrin	TERR-O-GAS 67	Li	67.0 + 31.8	1	1
metobromuron	PATORAN	WP	50	2.0	2
	PATORAN FL	Su	400 g/L	2.5	2
		Su	670 g/L	1.5	2
metolachlor	DUAL	EC	960 g/L	1.05	2
metolachlor/atrazine	PRIMEXTRA	Su	(3 to 2) 500 g/L	2.0	2
metolachlor/ metobromuron	GALEX 500	EC	300 g + 200 g/L	2.0	2
metribuzin	SENCOR, LEXONE	WP	50	2.0	2
	SENCOR 500	Su	500 g/L	2.0	2
	LEXONE L	Su	480 g/L	2.1	2
metribuzin	LEXONE DF	WG	75	1.33	2
	SENCOR 75 DF	WG	75	1.33	2
mineral oil herbicidal	AGRICULTURAL WED KILLER NO. 1	Li	100	1.0	6
	ESSO WEED KILLER	Li	100	1.0	6
monolinuron	AFESIN	EC	200 g/L	5.0	3
MYLONE	dazomet	Gr	50	2.0	2
naptalam	ALANAP	Sn	240 g/L	4.2	3
naptalam/dinitro	DYANAP	Sn	(2 to 1) 360 g/L	2.8	2
NaTA GRASS KILLER PELLETS	trichloroacetic acid, TCA	SG	85	1.2	3

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
ORNAMENTAL WEEDER	chloramben	GR	4	25.0	3
oxyfluorfen	GOAL	EC	192 g/L	5.2	1
paraquat	GRAMOXONE	Sn	200 g/L	5.0	2
paraquat/diquat	WEED AND GRASS KILLER, WEED-BAN	SG	(1 to 1) 5	20.0	3
paraquat/simazine	TERRAKLENE	Su	(1 to 4) 500 g/L	2.0	2
PARDNER	bromoxynil	EC	280 g/L	3.6	2
PATORAN	metobromuron	WP	50	2.0	2
PATORAN FL	metobromuron	Su	400 g/L	2.5	2
		Su	670 g/L	1.5	2
pebulate	TILLAM	EC	720 g/L	1.4	3
picloram	TORDON 10K	PE	10	10.0	2##
picloram/2,4-D	TORDON 101	SN	(1 to 4) 300 g/L	3.2	2##
POAST	sethoxydim	EC	184 g/L	5.4	3
POISON-IVY & BRUSH KILLER	ammonium sulfamate	Sn	500 g/L	2.0	3
POISON-IVY KILLER	amitrole-t	Sn	240 g/L	4.2	3
PREFAR	bensulide	EC	480 g/L	2.1	3
PREMIUM LAWN WEED KILLER	2,4-D/mecoprop	Sn	(1 to 1) 250 g/L	4.0	3
PRE-SAN	bensulide	EC	480 g/L	2.1	2
PRIMATOL	atrazine	Su	480 g/L	2.1	2
PRIMATOL NINE-O	atrazine	SG	90	1.1	2
PRIMEXTRA	metolachlor/atrazine	Su	(3 to 2) 500 g/L	2.0	2
PRINCEP-NINE-T	simazine	SG	90	1.1	2
prometryne	GESAGARD	WP	80	1.25	2
propyzamide	KERB	WP	50	2.0	3
propanil/MCPA (LV ester)	STAMPEDE CM	EC	460 g/L	2.2	2
PROPATURF	2,4-D/dichlorprop	EC	700 g/L	1.4	2
PYRAMIN FL	pyrazon	Su	430 g/L	2.3	3
pyrazon	PYRAMIN FL	See above			
RANDOX	CDAA, allidochlor	EC	480 g/L	2.1	1
		Gr	20	5.0	1
REGLONE	diquat	Sn	200 g/L	5.0	3
REGLONE A	diquat	Sn	200 g/L	5.0	2
RIVAL	trifluralin	EC	500 g/L	2.0	3
RO-NEET	cycloate	Gr	10	10.0	3
		EC	720 g/L	1.4	3
ROUNDUP	glyphosate	Sn	356 g/L	2.8	3
ROYAL MH60 SG	maleic hydrazide	SG	60	1.7	3
SABRE	bromoxynil/MCPA	EC	(1 to 1) 720 g/L	1.4	2
SENCOR 500 F	metribuzin	Su	500 g/L	2.0	2
SENCOR 50 WP	metribuzin	WP	50	2.0	2
SENCOR 75 DF	metribuzin	WG	75	1.33	2
sethoxydim	POAST	EC	184 g/L	5.4	3
SILVAPROP	2,4-D/dichlorprop	EC	700 g/L	1.4	2
SIMADEX	simazine	Su	500 g/L	2.0	2
		WP	80	1.25	2
SIMMAPRIM NINE-T	simazine	SG	90	1.1	2

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
simazine	PRINCEP-NINE-T	WG	90	1.1	2
	SIMMAPRIM NINE-T	SG	90	1.1	2
	SIMADEX	Su	500 g/L	2.0	2
		WP	80	1.25	2
SINBAR	terbacil	WP	80	1.25	2
SOIL KARE (MYLONE)	dazomet	Gr	50	2.0	2
SPIKE 80 WP	tebuthiuron	WP	80	1.25	2
SPIKE 5 G	tebuthiuron	Gr	5	20.0	3
STAMPEDE CM	propanil/MCPA (LV ester)	EC	(3.6 to 1) 460 g/L	2.2	2
SUTAN +	butylate/antidote	Gr	10	10.0	3
		EC	800 g/L	1.25	3
SUTAN +/ ATRAZINE	butylate/atrazine	Gr	(3 to 1) 24	4.2	2
SUTAZINE +	butylate/atrazine	EM	(4 to 1) 720 g/L	1.4	2
TARGET	dicamba/MCPA/mecoprop	Sn	400 g/L	2.5	3
TBA, trichlorobenzoic acid	TBA-4 General Weed Killer	Li	400 g/L	2.5	2
TBA-4 General Weed Killer	TBA	Li	400 g/L	2.5	2
TCA, trichloroacetic acid	NaTA GRASS KILLER PELLETS	SG	85	1.2	3
	sodium-TCA	SG	79.3	1.25	3
		SP	84, 85	1.2	3
		SP	95	1.05	3
tebuthiuron	SPIKE 80 WP	WP	80	1.25	2
	SPIKE 5 G	Gr	5	20.0	3
	HERBEC 20P	PE	20	5.0	2
TENORAN	chloroxuron	WP	50	2.0	3
terbacil	SINBAR	WP	80	1.25	2
terbutryn/ terbuthylazine	TOPOGARD	WP	50	2.0	2
TERRAKLENE	paraquat/simazine	Su	500 g/L	2.0	2
TERR-O-GAS 67	methyl bromide/chloropicrin	Li	67.0 + 31.8	1.0	1
TILLAM	PEBC, pebulate	EC	720 g/L	1.4	3
TOPOGARD	terbutryn/terbuthylazine	WP	50	2.0	2
TORCH	bromoxynil	EC	225 g/L	4.4	2
TORCH DS	bromoxynil	EC	450 g/L	2.2	2
TORDON 10 K	picloram	PE	10	10.0	2##
TORDON 101	picloram/2,4-D	Sn	(1 to 4) 300 g/L	3.2	2##
TREFLAN	trifluralin	EC	545 g/L	1.8	3
		Gr	1.47	68.0	3
triallate	AVADEX BW	EC	400 g/L	2.5	2
		Gr	10	10.0	2
trichloroacetic acid	TCA, sodium-TCA	See TCA above			—
trifluralin	RIVAL	EC	500 g/L	2.0	3
	TREFLAN	See TREFLAN			—
TROPOTOX	MCPB	Sn	400 g/L	2.5	3
TROPOTOX PLUS	MCPB/MCPA	Sn	(15 to 1) 400 g/L	2.5	3

TABLE 1. HERBICIDES USED IN ONTARIO (cont'd)

Common, Brand and Trade Names* (See footnote)	Example of Brand Name* Products or Common or other name of active ingredient	Formulation** (See footnote)	Guarantee % active unless stated	Conversion Factor (See footnote)	Ontario Schedule (See footnote)
UREABOR	borate mixture	Gr	98	1.0	2
VAPAM	metam-sodium	Sn	380 g/L	2.6	3
VECTAL	atrazine	WP	80	1.25	2
VEGETATION KILLER	amitrole/simazine	Su	(1 to 4) 50 g/L	20	3
VELPAR	hexazinone	SP	90	1.1	2
VERNAM	vernolate	EC	720 g/L	1.4	3
vernolate	VERNAM	See above			3
VORLEX PLUS	methyl isothiocyanate/ 1, 3 dichloropropene	Li	203 g/ 373 g/L	1.74	2
VORLEX PLUS CP	methyl isothiocyanate/ 1, 3 dichloropropene/ chloropicrin	Li	185 g/ 370 g/ 163 g/L	1.4	2
WEED AND GRASS KILLER	paraquat/diquat	SG	(1 to 1) 5	20.0	3
WEED-BAN	paraquat/diquat	SG	(1 to 1) 5	20.0	3
WEEDONE GARDEN WEEDER	chloramben	Gr	1.2	83.0	3

* Mention of a Brand or Trade name in this table does not constitute a guarantee or warranty of the product by the Ontario Weed Committee. Neither does this use signify that these products are approved to the exclusion of comparable products. All Trade names are capitalized.

** Symbols used are: EC = emulsifiable concentrate; EM = emulsion; Fl = flowable; Gr = granular; Li = liquid; PE = pellets; PS = pressurized spray; SG = soluble granules; Sn = solution; SP = soluble powder; Su = suspension (flowable); WG = wettable granule; WP = wettable powder.

ONTARIO CLASSIFICATION SCHEDULE

This column identifies the Schedules in which the BRAND NAME products listed in this Table are classified under the Pesticides Act.

Explanation of Schedules

Schedule 1 — Restricted. Use permit only.

Schedule 2 — Restricted to agriculturists, licensed exterminators and registered custom sprayers

Schedule 3 — May be available for "Domestic" purposes if so registered

Schedule 4 — "Domestic" products only

Schedule 5 — Limited to application on agricultural land

Scheudle 6 — Similar to Schedule 4 but may be registered for agricultural/commercial use.

For further information on the regulatory aspects of the classification please contact the Ministry of the Environment office nearest you.

Annual use permit required.

NOTES ON CHEMICALS

These notes should be considered with the recommendations given later in this publication. Additional information on use, toxicity and safety precautions is given here. With a few exceptions the chemicals are listed under their common (generic) rather than their trade or product name. See Table 1 to determine the corresponding common name for a particular trade name. For example, Table 1 indicates that the trade name AATREX has a common name of atrazine; notes on AATREX will be listed under atrazine in this section.

ADJUVANTS (see AGRAL 90, ASSIST OIL CONCENTRATE, BIVERT PH, CITOWETT PLUS, DEFOAMERS, DRIFT CONTROL AGENTS, FRIGATE, KORNOIL, KORNOIL CONCENTRATE, MINERAL OIL [NON-HERBICIDAL], MINERAL OIL/SURFACTANT [NON-HERBICIDAL], NALCO-TROL, NORBAK, SPRAY ADJUVANT DEFOAMER, SURFACTANTS)

AGRAL 90. TYPE OF ADJUVANT: Non-ionic surfactant. CHEMICAL COMPOSITION: Nonylphenoxy polyethoxy ethanol 90%. REGISTERED USES: For use with diquat and paraquat, and for washing sprayer tanks and equipment. BENEFIT: Improves chemical effectiveness. MODE OF ACTION: It is a wetting and spreading agent which improves coverage of spray mixes. MIXING: Use 250-1000 mL per 1000 L of spray as specified on label. Will mix with all types of water. Add AGRAL 90 to the spray mixture and agitate thoroughly. UNIQUE CHARACTERISTICS: Do not exceed the recommended rates of AGRAL 90 as too much wetter can lead to loss of spray due to excessive run-off.

ALLIDOCHLOR. TRADE NAME: RANDOX. CHEMICAL FAMILY: Acetamide. CROP AND/OR NON-CROP REGISTRATIONS: Onions on muck soil. SENSITIVE WEEDS: Lamb's-quarters, redroot pigweed, ragweed, annual grasses. UPTAKE AND TRANSLOCATION: Absorbed mainly by coleoptiles of grass seedlings. Not readily translocated. Probably accumulates in the crown and first internode of the grass seedlings. BASIS OF SELECTIVITY: Tolerant species detoxify allidochlor by metabolizing it. APPLICATION METHODS: Preemergence and early postemergence 4 to 6 weeks after planting. Liquid formulation applied preemergence at low volumes (150 to 300 L water/ha) or postemergence at high volumes (900 to 2000 L water/ha). Granular formulation used postemergence to the crop. RESIDUAL ACTIVITY: 3 to 6 weeks under warm moist soil conditions. UNIQUE CHARACTERISTICS: Very soluble. During heavy rainfall, leaches readily to the onion roots causing crop injury. The chemical and its vapors cause irritation to the eyes and skin. Precautions should be taken to avoid spilling on hands or clothing and to avoid inhaling fumes. Keep containers tightly sealed when not in use. Open indoors only when adequate ventilation is provided. The material is not corrosive to spray equipment. A permit from the Ministry of the Environment is required for its use.

AMITROLE/AMMONIUM THIOCYANATE (amitrole). TRADE NAMES: AMITROL-T. CHEMICAL FAMILY: Triazole. CROP AND/OR NON-CROP REGISTRATIONS: Preplant in corn, soybeans and white beans. Post harvest in corn, soybeans, white beans, grain, peas, alfalfa, clover and asparagus. In-season weed control in apples. Shelterbelts. Non-crop areas. Marshes and ditches. Spot treatment in pastures. SENSITIVE WEEDS: Many annual and perennial broadleaf weeds and grasses including quack grass, Canada thistle, sow-thistle, poison-ivy, poison-oak, toadflax, milkweed, hoary cress, leafy spurge, horsetail, cattail, honeysuckle, locust, ash, sumac. UPTAKE AND TRANSLOCATION: Absorbed by foliage and roots. Translocates well in xylem and phloem. Accumulates in growing regions of plant. BASIS OF SELECTIVITY: Resistant plants metabolize amitrole more rapidly than sensitive plants and may have lower uptake as a result of leaf structure which reduces wetting and penetration. APPLICATION METHODS: Foliar postemergence application to actively growing plants. Good coverage is essential. If weeds are mature, it is advisable to cut them and then spray the regrowth. Do not disturb treated plants for at least two weeks after application. Do not make postharvest applications after October 1. For control of quack grass and Canada thistle apply in spring or fall to actively growing plants 15-20 cm tall; wait 10-14 days and then plough or disk. RESIDUAL ACTIVITY: Approximately two to four weeks in moist warm soil. UNIQUE CHARACTERISTICS: Most crops are sensitive if contacted. Poor results may occur: if spray coverage is inadequate, if plants are drought stressed or overmature, or if heavy rains fall within 12 hours after application. Do not graze or plant to grain, peas, alfalfa or clover for 8 months after treatment. Do not graze spot treated areas in pastures for 6 months following treatment.

AMITROLE/SIMAZINE. TRADE NAME: AMIZINE. CHEMICAL FAMILY: Triazole/triazine. CROP AND/OR NON-CROP REGISTRATIONS: Established apples, substations, storage yards, driveways, parking areas, and roadsides. SENSITIVE WEEDS: Annual and perennial grasses and broadleaf weeds, including quack grass and Canada thistle. UPTAKE AND TRANSLOCATION: Absorbed by roots and shoots. Translocated readily and accumulates in meristems. BASIS OF SELECTIVITY: Nonselective. APPLICATION METHODS: Foliar postemergence application with knapsack sprayer or high volume sprayer (800 L water per hectare). Apply before fruit starts to form (before 90% petal fall). RESIDUAL ACTIVITY: Several months to more than one year. UNIQUE CHARACTERISTICS: Amitrole destroys existing vegetation, while simazine leaves a season-long residue. Uniform coverage is important, and touchups may be necessary. Avoid contact with desirable vegetation including tree trunks.

AMMONIUM SULPHAMATE. TRADE NAME: POISON IVY AND BRUSH KILLER. CHEMICAL FAMILY: Ammonium sulfamate. CROP AND/OR NON-CROP REGISTRATIONS: Used in non-crop land for the elimination of weeds and small brush, and as a stump treatment to prevent resprouting. SENSITIVE WEEDS: Most woody plants, grasses and herbaceous broadleaf weeds including poison-ivy. UPTAKE AND TRANSLOCATION: Rapidly absorbed through foliage and green stems as well as through freshly cut wood surfaces. Translocation has been demonstrated in woody and herbaceous plants. BASIS

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

OF SELECTIVITY: Non-selective. APPLICATION METHODS: Applied as a foliar spray or as a concentrated solution to cut woody surfaces. RESIDUAL ACTIVITY: Herbicidal activity in soil does not normally persist longer than 6 to 8 weeks. UNIQUE CHARACTERISTICS: Non-flammable, non-volatile but corrosive to equipment. Wash equipment thoroughly after use and avoid prolonged contact with the skin.

ASSIST OIL CONCENTRATE. TYPE OF ADJUVANT: Mineral oil/surfactant (non-herbicidal). CHEMICAL COMPOSITION: 83% paraffin base mineral oil plus 17% surfactant blend. REGISTERED USES: ASSIST OIL CONCENTRATE is registered for use with POAST, BASAGRAN, LADDOCK and Atrazine. BENEFIT: The use of ASSIST results in improved postemergence activity and a greater degree of consistency under varying environmental conditions. ASSIST will also aid in providing a faster weed kill. MODE OF ACTION: Reduces the evaporation of spray droplets on the leaf surface leading to a longer period for penetration. Improves penetration through the leaf cuticle layer. ASSIST also aids in spreading a spray droplet on the leaf surface so that it covers a greater surface area. MIXING: Fill the spray tank half full with water and begin agitation. Add the desired amount of herbicide and continue filling. Add ASSIST last. After filling, continue agitation. Agitate thoroughly after any stoppage in spraying. UNIQUE CHARACTERISTICS: May cause increased temporary topical burn to crop plants under hot humid weather conditions.

ATRAZINE. TRADE NAMES: AATREX, PRIMATOL, VECTAL. CHEMICAL FAMILY: S-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field, seed and sweet), low bush blueberries, triazine-resistant canola and non-cropland. SENSITIVE WEEDS: Will control a wide range of annual grasses and broadleaf weeds such as mustards, purslane, ragweed, smartweed, lady's-thumb, wild buckwheat, lamb's-quarters, pigweed, volunteer clover, barnyard grass, green foxtail, yellow foxtail, and wild oats. Will also control quack grass, Canada thistle, and nutsedge. Populations of lamb's-quarters, pigweed, ragweed and witch grass have been found which are resistant to atrazine and are therefore not controlled. UPTAKE AND TRANSLOCATION: Actively absorbed by roots and foliage although foliar absorption is usually small. It is translocated to the top of the plant and accumulates in the leaf margins and the growing points. BASIS OF SELECTIVITY: Metabolism by tolerant species. Spray timing avoids contact with low bush blueberries to prevent injury. APPLICATION METHODS: For corn, preplant incorporated, preemergence, or postemergence (with or without oil) usually before the annual weeds are more than 4 cm high; under dry weather conditions a shallow incorporation may enhance activity; oil or oil/surfactant blends will increase the postemergence activity. For low bush blueberries, preemergence application. For triazine-resistant canola, postemergence. Dry bulk fertilizer may be impregnated with atrazine and applied preplant incorporated. Atrazine may be tank mixed with several other annual grass and broadleaf herbicides to increase the spectrum of weed control in corn. Split applications can be used to improve the control of some perennial weeds. RESIDUAL ACTIVITY: Can persist in the soil for varying lengths of time depending on rate, weather and soil conditions (longer under dry, cool weather conditions and in sandy soils). Postemergence treatments tend to persist longer than preemergence treatments. See section "Special Notes for Corn". UNIQUE CHARACTERISTICS: Atrazine may carry over for more than one planting season. One year after application there is usually no hazard to most rotational crops when 2 kg ai/ha or less is applied. Cool, dry weather and sandy soils are conditions under which problems may arise. Perennial weed control usually requires higher rates of atrazine, in which case, corn must be grown for more than one year. See "Notes on atrazine and simazine soil residues" in "Special Notes for Corn".

ATRAZINE/SIMAZINE. TRADE NAMES: EKKO, ERAMOX. CHEMICAL FAMILY: S-triazine/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: EKKO for corn (ensilage, field, seed and sweet). ERAMOX for non-crop land. SENSITIVE WEEDS: At the rates used on corn the following are controlled: mustards, ragweed, lady's-thumb, lamb's-quarters, purslane, smartweed, wild buckwheat, redroot pigweed, barnyard grass, yellow foxtail, green foxtail, witch grass, wild oats, crab grass; perennial weeds such as quack grass, Canada thistle, and nutsedge can be controlled with split applications — see product label for specifics and precautions. At rates used for non-crop land most annual and perennial herbaceous weeds are controlled. UPTAKE AND TRANSLOCATION: Absorbed by roots and foliage, although foliar absorption is usually small. It is translocated to the top of the plant and accumulates in the leaf margins. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: For corn: preplant incorporated, preemergence or postemergence with oil; preplant incorporation must be shallow with a harrow or cultivator as a disc usually incorporates too deep; rainfall is required to activate a preemergence application; postemergence applications must be made in an oil-water emulsion when grasses are in the 1 to 2 leaf stage and broadleaves are no higher than 10 cm. For non-crop land: preemergence and postemergence. RESIDUAL ACTIVITY: At rates recommended for corn, crops other than corn should not be planted for at least one year; two years after application, most rotational crops can be planted except for tobacco which should not be planted within three years. At the higher rates recommended for non-crop land weeds will usually be controlled for two seasons or more. UNIQUE CHARACTERISTICS: Triazine-resistant weed species will not be controlled. Where crab grass exists in corn in heavy populations, a cultivation will be necessary. Atrazine/simazine is not recommended for muck soils. Since atrazine/simazine has a long residual period corn must follow corn for at least one year. See the product label for specific instructions with respect to carryover. Uneven application (overlapping, etc.) may result in even longer carryover. At non-crop land rates, trees and ornamentals are likely to be damaged if their roots extend into the treated zone. Do not apply to frozen or snow covered ground.

BENSULIDE. TRADE NAMES: BETASAN, PREFAR, PRE-SAN. CHEMICAL FAMILY: Benzenesulfonamide. CROP AND/OR NON-CROP REGISTRATIONS: BETASAN and PRE-SAN for lawns and turf. PREFAR for cucumbers. SENSITIVE WEEDS: Germinating annual

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

grasses such as annual blue grass, barnyard grass, crab grass, and foxtail. Some control of redroot pigweed, lamb's-quarters, and shepherd's-purse. UPTAKE AND TRANSLOCATION: Adsorbed on root surfaces and a small amount is absorbed by the roots. Little or none is translocated upward to the leaves. BASIS OF SELECTIVITY: Inhibits root growth and partially inhibits cell division in sensitive seedlings. Sensitive species affected only in seedling stage. Metabolized by established grasses. APPLICATION METHODS: Preemergence in spring or fall for turf (well established only); a higher rate is required for fall applications to control germinating weeds the following spring; incorporate by lightly irrigating into soil. Preplant incorporated for cucumbers (on mineral soil only); incorporate to 3-5 cm depth; it may also be applied preemergence if incorporated by sprinkler or furrow irrigation. RESIDUAL ACTIVITY: Season long weed control. Degraded slowly by soil microorganisms with a half-life of 4-6 months depending on soil type. Because of soil residues, only cucurbits, cole crops, carrots, lettuce, peppers and tomatoes should be planted the following year. UNIQUE CHARACTERISTICS: Bensulide is inactivated in soils containing high amounts of organic matter (muck soils). Incorporation recommended to avoid photodecomposition. PREFAR may also be tank mixed with naptalam and applied preplant incorporated in cucumbers for broad spectrum control of germinating annual broadleaf and grassy weeds. Do not reseed lawn within one year of application. Formulations available with fertilizers for home owner lawn use.

BENTAZON. TRADE NAME: BASAGRAN. CHEMICAL FAMILY: Benzothiadiazine. CROP AND/OR NON-CROP REGISTRATIONS: peas, flax, soybeans, dry and snap beans, lima beans, faba beans, peanuts, corn and turf. SENSITIVE WEEDS: Annual broadleaf weeds including hairy nightshade, lamb's-quarters*, redroot pigweed*, low cudweed, purslane, common ragweed*, wild radish, Russian thistle, hairy galinsoga, corn spurry, bird rape, flower-of-an-hour, buttercups, common groundsel*, jimsonweed, giant ragweed, velvetleaf, lady's-thumb, wild mustard, cocklebur, stinkweed, shepherd's-purse and common chickweed. (*Triazine-resistant strains of these weeds are also controlled). Topgrowth of Canada thistle and nutsedge. Field bindweed may be suppressed by two applications applied 10 days apart. UPTAKE AND TRANSLOCATION: Taken up through the foliage. Not translocated. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Postemergence. Apply when weeds are small and actively growing. Crop must be in a tolerant growth stage (see specific recommendations and label). Thorough spray coverage is necessary. Use flat fan or hollow cone nozzles tilted 45° forward. Use ASSIST OIL CONCENTRATE for improved control. Use only CITOWETT PLUS on peas. The ASSIST rate should be reduced under hot humid conditions. Aircraft application is a registered use on soybeans, dry and snap beans. RESIDUAL ACTIVITY: Essentially none. UNIQUE CHARACTERISTICS: Temporary crop injury can be expected if bentazon is applied during hot humid weather or if crop is stressed (flooding, drought, cold). Cool weather or drought may delay control. Rainfall within 6 to 8 hours after application may reduce effectiveness. Since there is no residual activity a new flush of weeds may emerge after the first flush has been controlled.

BENTAZON/ATRAZINE. TRADE NAME: LADDOK. CHEMICAL FAMILY: Benzothiadiazine/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field, seed and sweet). SENSITIVE WEEDS: Annual broadleaf weeds such as black nightshade, redroot pigweed, lamb's-quarters, low cudweed, purslane, common ragweed, Russian thistle, corn spurry, flower-of-an-hour, lady's-thumb, wild mustard, hairy galinsoga, bird rape, buttercup, common chickweed, common groundsel, jimsonweed, giant ragweed, velvetleaf and cocklebur. Triazine-resistant varieties are also controlled. Top growth of Canada thistle and nutsedge are controlled. Field bindweed may be suppressed. UPTAKE AND TRANSLOCATION: Uptake into the plant occurs primarily through the leaves. Bentazon/atrazine has mainly contact action and translocation is minimal. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Bentazon/atrazine should be applied early postemergence when weeds are small and actively growing. Apply in 200-400 L water/ha. Application should be made before weeds reach the maximum size listed on the label. This generally corresponds to corn in the one to five leaf stage. Under good growing conditions, the most effective time for spraying will usually be 18 to 28 days after planting. ASSIST OIL Concentrate should be added to the spray tanks for all applications. Thorough spray coverage is important and flat fan or hollow cone nozzles should be used. The use of flood jet nozzles is not recommended because of inadequate coverage. RESIDUAL ACTIVITY: Injury may occur to any crop other than corn planted in the same season on land treated with bentazon/atrazine. In the season after application, there is virtually no hazard to most rotational crops when label rates for annual weed control have been used. Overlap or the use of a double application for nutsedge control may result in injury to rotational crops due to carryover of the atrazine component of bentazon/atrazine. UNIQUE CHARACTERISTICS: Corn is tolerant at all stages of growth. Rainfall within 6 to 8 hours of application may reduce effectiveness of the spray solution. Bentazon/atrazine should not be applied when crop is under stress from prolonged cold wet weather, poor fertility, or other factors.

BIVERT PH. TYPE OF ADJUVANT: Drift control agent. CHEMICAL COMPOSITION: Dimethylalkyl amine. REGISTERED USES: In combination with phenoxy herbicides for roadsides and rights-of-way (non-crop). BENEFIT: Drift control. MODE OF ACTION: When combined with fuel oil, constitutes the oil phase in a bifluid system to produce a thick water-in-oil (invert) emulsion. MIXING: Special bifluid apparatus required. Follow manufacturer's instructions. UNIQUE CHARACTERISTICS: A closed system is required to maintain a mayonnaise type consistency. The presence of air in the suction lines will cause the invert to collapse.

BROMACIL. TRADE NAME: HYVAR. CHEMICAL FAMILY: Uracil. CROP AND/OR NON-CROP REGISTRATIONS: Non-crop land for total vegetation control and as a spot treatment to control brush. SENSITIVE WEEDS: Annual and perennial broadleaved weeds and grasses (broad-

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

cast application). Several brush species (spot application). UPTAKE AND TRANSLOCATION: Most readily absorbed through the roots. Surfactants can enhance foliar activity. Translocation is upward with the movement of water to leaves where it inhibits photosynthesis. BASIS OF SELECTIVITY: Non-selective at normal rates. APPLICATION METHODS: For herbaceous weeds, broadcast sprayed, preferably just before or during periods of active weed growth. For brush, spot applications with an exact delivery hand gun either at the base of target brush or on a grid. RESIDUAL ACTIVITY: half-life was 5-6 months for 4.4 kg/ha bromacil in a silty loam soil. UNIQUE CHARACTERISTICS: Bromacil should not be used where it is likely to leach, wash or move with eroded soil into contact with the roots of desirable trees and shrubs. Do not apply to brush standing in water.

BROMACIL/DIURON. TRADE NAME: KROVAR I. CHEMICAL FAMILY: Uracil/substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Non-crop land. SENSITIVE WEEDS: Most herbaceous weeds. BASIS OF SELECTIVITY: Non-selective. APPLICATION METHODS: Broadcast sprayed just before or during the period of active weed growth. UNIQUE CHARACTERISTICS: Normally fewer species of weeds escape or regrow after use of this mixture compared to use of the same amount of either chemical alone. See also notes on bromacil and diuron.

BROMOXYNIL. TRADE NAMES: PARDNER, TORCH. CHEMICAL FAMILY: Hydroxybenzonitrile. CROP AND/OR NON-CROP REGISTRATIONS: Spring wheat, barley, oats, corn, fall rye, triticale and many other grasses. SENSITIVE WEEDS: Wild buckwheat, smartweed, lamb's-quarters and wild mustard are killed if the chemical thoroughly contacts these plants before they have more than 4 true leaves. Most established perennial broadleaf weeds, chickweed and grasses tolerate field applications of this herbicide. UPTAKE AND TRANSLOCATION: Absorbed by plant foliage and moves very little within the plant. BASIS OF SELECTIVITY: Differential spray retention, uptake, translocation and degradation. APPLICATION METHODS: Postemergence. RESIDUAL ACTIVITY: Essentially no soil residual activity. UNIQUE CHARACTERISTICS: Crop injury symptoms (leaf scorch) may develop if the plant is under stress within 2 or 3 days before or after spraying; this stress could be caused by high temperatures or high humidity or in the case of corn, application following a period of cool, wet weather; such injury usually does not affect yields. The formulation includes a wetting agent to improve the spread of droplets on the leaf. Although bromoxynil is not an effective soil-applied herbicide, broadleaf crops such as turnips, peas and beans should not be seeded for a week after spray application.

BROMOXYNIL/MCPA. TRADE NAMES: BROMOX 450M, BUCTRIL M, SABRE. CHEMICAL FAMILY: Hydroxybenzonitrile/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Spring and winter wheat, barley, oats, flax, fall rye, corn and canary grass. UNIQUE CHARACTERISTICS: Combination of bromoxynil with MCPA provides better control of mustards than bromoxynil alone. See also notes on bromoxynil and MCPA.

BUTYLATE/R25788 (butylate +). TRADE NAME: SUTAN+. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field and sweet). SENSITIVE WEEDS: Annual grasses such as wild oats, crab grass, barnyard grass, green foxtail, yellow foxtail, witch grass, and fall panicum; also yellow nutsedge. UPTAKE AND TRANSLOCATION: Uptake by underground plant parts (roots, hypocotyl and seed), then upward translocation to the growing tip. BASIS OF SELECTIVITY: Metabolized by tolerant species at the seed germination stage. R25788 enhances the enzymatic breakdown of the herbicide in tolerant species. Seed food reserves permit seedling to outgrow chemical effect. APPLICATION METHODS: May be applied using water or liquid fertilizers as the carrier. Dry fertilizers may also be used as a carrier when impregnated by licensed fertilizer dealers. To prevent chemical loss and reduced weed control, butylate/R25788 should be uniformly incorporated in the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be to a dry soil surface and incorporation should be within four hours for liquid application or within the same day when impregnated on dry fertilizer. RESIDUAL ACTIVITY: Provides season long weed control with no soil residues the following year to prevent crop rotation. In tank-mix combinations with atrazine, there may be atrazine residues when the highest atrazine rate is used. UNIQUE CHARACTERISTICS: Does not need rainfall to be activated and will not leach significantly under heavy rainfall. This herbicide may be successfully tank mixed with triazine herbicides (atrazine or cyanazine) for excellent broad spectrum broadleaf and grass control.

CHLORAMBEN. TRADE NAMES: AMIBEN, ORNAMENTAL WEEDER. CHEMICAL FAMILY: Benzoic acid. CROP AND/OR NON-CROP REGISTRATIONS: Asparagus, carrots, dry beans, kidney beans, lima beans, transplanted peppers, white potatoes, pumpkins, snapbeans, soybeans, squash, sunflowers, transplanted tomatoes, white beans, woody nursery stock, iris, gladioli and annual flowers. SENSITIVE WEEDS: Annual broadleaf weeds including chickweed, lamb's-quarters, pigweed, ragweed, smartweed and velvetleaf. Annual grasses including barnyard grass, large crab grass, smooth crab grass, green foxtail and yellow foxtail. UPTAKE AND TRANSLOCATION: Primarily taken up through roots, emerging shoots or coleoptile/hypocotyl. BASIS OF SELECTIVITY: Tolerant species form inactivated conjugates (glucose-chloramben conjugate) more rapidly than do susceptible species. Limited foliar absorption and translocation. APPLICATION METHODS: Preplant incorporated, preemergence and postemergence. For preplant incorporated the chemical should be incorporated in the top 0-5 cm of the soil using most forms of secondary tillage equipment; incorporation should be completed with two passes of the tillage equipment at right angles. For postemergence in soybeans apply when beans are in the cracking to second trifoliate stage of growth. For postemergence control of velvetleaf and smartweed, apply when these species are

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

2-10 cm tall. The granular formulations have no postemergence activity and must be applied prior to weed emergence. RESIDUAL ACTIVITY: Six to eight weeks in soil. UNIQUE CHARACTERISTICS: When applied preemergence, chloramben requires rainfall to be activated; if sufficient rainfall does not fall within seven days after spraying chloramben, but there is enough moisture to germinate weeds and grasses, a light cultivation with a rotary hoe will uproot these small weeds and incorporate the herbicide into the germinating weed seed zone.

CHLOROXURON. TRADE NAME: TENORAN. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Strawberries. SENSITIVE WEEDS: Annual wormwood, cocklebur, chickweed, goosefoot, green smartweed, groundsel, lady's-thumb, lamb's-quarters, nightshade, pigweed, purslane, ragweed, and shepherd's-purse. UPTAKE AND TRANSLOCATION: Strongly absorbed by roots, and to a lesser extent, by the foliage. Translocated to leaves. BASIS OF SELECTIVITY: Crop is tolerant. APPLICATION METHODS: Apply just after weed emergence but before weeds are 5 cm high. Multiple applications can be used during the season if preceded by clean cultivation. Do not apply within 60 days of harvest. Under dry conditions irrigate before or immediately after treatment. RESIDUAL ACTIVITY: 3-6 weeks. UNIQUE CHARACTERISTICS: Can be used in new plantings once transplants are established.

CHLORPROPHAM. TRADE NAMES: CHLORO IPC, SPROUT NIP. CHEMICAL FAMILY: Phenylcarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Soybeans, field peas, cow peas, peas, carrots, dill, lettuce, onions, snapbeans, spinach, cane fruit, daffodils, gladioli, iris, tulips, and ornamental nursery stock; postharvest sprout inhibition of stored potatoes. SENSITIVE WEEDS: Annual broadleaf and grass weeds including purslane, chickweed, smartweed, carpetweed, false flax, annual bluegrass, crab grass, rye grass, stink grass and dodder. UPTAKE AND TRANSLOCATION: Readily translocated to the leaves following root absorption. Vapors have been demonstrated to be absorbed by seeds and emerged dodder. BASIS OF SELECTIVITY: Rapid degradation in tolerant plants as well as soil adsorption. APPLICATION METHODS: Preemergence and directed postemergence in specified crops. RESIDUAL ACTIVITY: Tightly bound to soil colloids. The rate of dissipation can vary greatly with microbial activity and moisture level. Both high soil temperature and excessive soil moisture increase the rate of dissipation. UNIQUE CHARACTERISTICS: Use the lower rates on sandy or coarse textured soils and the higher rates on clay or muck soils. Weed control is most effective when soil temperatures are below 16°C. The lower rates should be used when soil temperature is below 16°C. The soil must be moist for effective weed control.

CHLORSULFURON. TRADE NAME: GLEAN. CHEMICAL FAMILY: Sulfonyl urea. CROP AND/OR NON-CROP REGISTRATIONS: Non-crop land. SENSITIVE WEEDS: Annual and perennial broadleaf weeds such as wild carrot, Canada thistle, sow thistle, scentless chamomile, lamb's-quarters, wild mustard, redroot pigweed, stinkweed, cow cockle, chickweed and Russian thistle. UPTAKE AND TRANSLOCATION: Thoroughly systemic after absorption by either foliage or roots. Foliar absorption is rapid. BASIS OF SELECTIVITY: A disruption of amino acid metabolism leads to an inhibition of cell division in sensitive plants. Faster rates of metabolic detoxification have been observed in tolerant species. APPLICATION METHODS: Preemergence or early postemergence. RESIDUAL ACTIVITY: Half-life is 4 to 6 weeks under growing season conditions. Degradation is faster with higher soil temperatures and/or lower soil pH. UNIQUE CHARACTERISTICS: Although degradation is moderately rapid, extremely low soil residues can be highly toxic to some broadleaf weeds, such as wild carrot, for up to two years after application.

CHLORTHAL DIMETHYL. TRADE NAME: DACTHAL. CHEMICAL FAMILY: Phthalate. CROP AND/OR NON-CROP REGISTRATIONS: Broccoli, brussels sprouts, cabbage, cauliflower, dry and snap beans, eggplant, established ornamentals, field beans, garlic, lawns and turf, onions, peppers, potatoes, seeded melons, soybeans, strawberries, sweet potatoes, tomatoes, gladioli and woody nursery stock. SENSITIVE WEEDS: Germinating annual grasses and certain annual broadleaf weeds such as lamb's-quarters, purslane, common chickweed, redroot pigweed, carpetweed and ground-cherry. UPTAKE AND TRANSLOCATION: Absorbed by roots but not foliage. No translocation within plant. BASIS OF SELECTIVITY: Inhibits growth of germinating seeds; exact mechanism not yet known. APPLICATION METHODS: Must be applied prior to weed seed germination. Depending on the crop, may be applied preplant incorporated, preemergence, postemergence or post-transplant to crop. At least 1 cm of water as either rain or irrigation is necessary to activate the herbicide. In turf, spring or fall application is satisfactory. RESIDUAL ACTIVITY: Average half-life is 100 days in most general soil types. Effective weed control may be maintained for as long as two months depending on application rate and soil type. UNIQUE CHARACTERISTICS: May be applied over the top of most plants with no phytotoxic effects. Little herbicidal activity against velvetleaf, common ragweed, mustards, jimsonweed, galinsoga, smartweed, nutsedge and cocklebur. Established turf grasses (with the possible exception of the bent grasses) have good tolerance. Lawns and turf should not be reseeded for 60 days after treatment. Use only on mineral soils.

CITOWETT PLUS. TYPE OF ADJUVANT: Nonionic spreader sticker surfactant. CHEMICAL COMPOSITION: Octylphenoxypolyethoxy ethanol 50%. REGISTERED USES (CROP/HERBICIDE): Corn/atrazine; sugar beets and red beets/pyrazon; peas/bentazon. BENEFIT: Improves postemergence control of weeds which have reached their upper limit in size for susceptibility. MODE OF ACTION: Causes the spray mix to form a continuous film on leaf surfaces; also makes herbicide more rainfast. MIXING: Fill tank about half full with water; add herbicide with continuous agitation; complete filling of tank with water; add CITOWETT with continuous agitation. UNIQUE CHARACTERISTICS: Higher rates are required with hard water.

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

COPPER CITRATE AND GLUCONATE. TRADE NAME: ALGIMYCIN PLL-C. CHEMICAL FAMILY: Chelates of copper gluconate and copper citrate. CROP AND/OR NON-CROP REGISTRATIONS: Algae control in wholly enclosed farm, fish and fire ponds having no outflow beyond the property limits of the user. SENSITIVE WEEDS: Most algae including *Spirogyra, Ulothrix, Cladophora, Chara and Nitella*. UPTAKE AND TRANSLOCATION: No information available. BASIS OF SELECTIVITY: Non-selective. APPLICATION METHODS: Available as a tablet or a liquid formulation. Apply early in the season where algae is well established and growing vigorously. Apply early in the day as sunlight enhances the effectiveness of the treatment. To ensure even distribution, apply tablet formulation with a hand scoop. Apply liquid directly onto floating mats of algae or inject below surface for algae growing on the bottom of the pond, with a small hand sprayer or back-pack sprayer. To avoid oxygen depletion, treat 1/3 to 1/2 of the water area in a single operation and wait at least 10 to 14 days between treatments. RESIDUAL ACTIVITY: One application of the tablet formulation of ALGIMYCIN should provide control over the entire year. When using liquid ALGIMYCIN, a second treatment or spot treatment later in the season may be required. UNIQUE CHARACTERISTICS: The tablet formulation is more effective than the liquid formulation for the control of *Chara* and *Nitella*. Not for use in public waters or waters that drain into public waters. Do not apply in deep waters. May be toxic to trout and other species of fish. Do not apply directly to crop plants, seedling grasses or non-established ornamental plants, as injury may result. Not for use in potable water systems.

COPPER ETHANOLAMINE. TRADE NAME: CUTRINE-PLUS. CHEMICAL FAMILY: Mixture of chelates of copper ethanolamines. CROP AND/OR NON-CROP REGISTRATIONS: Algae control in wholly enclosed farm, fish and fire ponds and fish hatcheries having no outflow beyond the property limits of the user. SENSITIVE WEEDS: *Microcystis, Oscillatoria, Anabaena, Aphanizomenon, Spirogyra, Cladophora, Vaucheria, Ulothrix, Chara and Nitella*. UPTAKE AND TRANSLOCATION: No information available. BASIS OF SELECTIVITY: Non-selective. APPLICATION METHODS: Available as a granular or a liquid formulation. Apply early in the day as ample sunlight is required for maximum control. To ensure even distribution of the granular formulation, employ a scoop or dry fertilizer spreader. Use a hand or power sprayer for best distribution of the liquid formulation. To avoid oxygen depletion, treat only 1/3 to 1/2 of the pond at a time. Allow 1-2 weeks between treatments. RESIDUAL ACTIVITY: One application of granular CUTRINE-PLUS should provide control over the entire season. When using liquid CUTRINE-PLUS, a second treatment later in the season may be required. UNIQUE CHARACTERISTICS: Not for use in potable waters. Not for use in public waters or waters that drain into public waters. Extremely toxic to fish in soft waters; toxic in hard waters if the maximum recommended concentration is exceeded; if fish are present but water hardness is not known, do not use CUTRINE-PLUS. Treated areas may be used for swimming or fishing immediately after treatment. Water from treated ponds may be used to irrigate turf, fairways, putting greens and ornamental plants.

CYANAZINE. TRADE NAME: BLADEX. CHEMICAL FAMILY: S-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field and sweet), triazine-tolerant canola. SENSITIVE WEEDS: Black nightshade, purslane, lady's-thumb, lamb's-quarters, prostrate knotweed, shepherd's-purse, wild buckwheat, wild mustard, wormseed mustard, velvetleaf, pigweed, crab grass, green foxtail, yellow foxtail, witch grass, fall panicum, and barnyard grass. UPTAKE AND TRANSLOCATION: Readily absorbed by roots and foliage. When absorbed by roots it is translocated to the leaves. BASIS OF SELECTIVITY: Metabolism by tolerant crops. APPLICATION METHODS: Preplant incorporated in corn (wettable powder) but only in mixtures with other corn herbicides; incorporation equipment should be set to work no deeper than 10 cm. Preemergence in corn (wettable powder); moisture is required for activation. Early postemergence in corn up to the 3 leaf stage (wettable powder). Early postemergence in triazine-tolerant canola (liquid formulation). RESIDUAL ACTIVITY: Cyanazine has a relatively short residual life in the soil; from normal spring applications there is no carryover of the herbicide to the next growing season. UNIQUE CHARACTERISTICS: Cyanazine is a short-lived triazine herbicide with flexible application time. Preemergence applications do not adequately control barnyard grass, fall panicum or pigweed under conditions which delay germination such as low temperature or dry soil surface. Emerged velvetleaf will be controlled by the early postemergence application but subsequent germinating velvetleaf will not be controlled. Cyanazine is not recommended alone for use on heavy clay soil. Do not use on peat, muck soils, sandy soils or soils with less than 1% organic matter. Do not use the liquid formulation postemergence in corn. Do not add oil or surfactants other than as specified on the label. Cyanazine may be used in tank mixes and has been formulated with various other herbicides. See label for specifications.

CYANAZINE/ATRAZINE. TRADE NAME: BLAZINE. CHEMICAL FAMILY: S-triazine/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field and sweet). SENSITIVE WEEDS: Nightshade, purslane, lady's-thumb, lamb's-quarters, pigweed, prostrate knotweed, ragweed, shepherd's-purse, wild buckwheat, mustard and early germinating velvetleaf. Barnyard grass, crab grass, green foxtail, witch grass, yellow foxtail and early germinating fall panicum. UPTAKE AND TRANSLOCATION: Readily absorbed by the roots and foliage and translocated to the top of the plant. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Preplant incorporated, preemergence, and early postemergence (wettable powder only) over a wide range of soil types and weather conditions. Incorporation equipment should be set to work at 5-10 cm depth. Immediate incorporation is not necessary. Preemergence activity is dependent on root uptake; thus a shallow incorporation into moist soil is necessary if at least 1.25 cm of rain does not fall within 7-10 days after application. Incorporation into dry soil is not recommended. Early postemergence application should be made when grasses are in the 1 to 2 leaf stage

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

and broadleaf weeds are less than 5 cm high. DO NOT apply to corn beyond the 3 leaf stage. DO NOT add oil or surfactants. Use only wettable powder formulation for postemergence application. Can be tank mixed with dicamba for velvetleaf and triazine-resistant weed control. RESIDUAL ACTIVITY: Normally, season long activity. UNIQUE CHARACTERISTICS: Do not use on sandy soil (70% or more sand) or soils with less than 1% organic matter. Do not add oil or surfactants when used postemergence. Do not use liquid formulation postemergence. Cyanazine/atrazine provides improved control of barnyard grass and pigweed over cyanazine or atrazine alone. Damage from postemergence applications to corn under stress due to cold wet growing conditions is usually temporary unless the weather conditions are prolonged.

CYANAZINE/MCPA (1:2). TRADE NAME: BLAGAL. CHEMICAL FAMILY: Triazine/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Spring wheat, barley, oats, flax and mixed grain. SENSITIVE WEEDS: Tartary buckwheat, wild buckwheat, green smartweed, lady's-thumb, hemp-nettle, stinkweed, corn spurry, wild radish, horsetail (top growth), chickweed, lamb's-quarters, ball mustard, wild mustard, wormseed mustard, tumble mustard, Canada thistle (top growth) and other MCPA-susceptible weeds. UPTAKE AND TRANSLOCATION: Readily absorbed by leaves of susceptible plants and translocated to the growing points. BASIS OF SELECTIVITY: The low rate of cyanazine is generally non-toxic to the crop. Grasses are not affected by MCPA. APPLICATION METHODS: Postemergence when the crop is in the 2 to 5 leaf stage, and weeds are small (have less than 5 leaves) and actively growing. RESIDUAL ACTIVITY: A few days to a week, depending on soil moisture. UNIQUE CHARACTERISTICS: May cause temporary yellowing of lower leaves if crop is under stress due to lack of moisture or temperature extremes.

CYCLOATE. TRADE NAME: RO-NEET, CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Red beets, spinach. SENSITIVE WEEDS: Crab grasses, barnyard grass, foxtails, yellow nutsedge and some annual broadleaf weeds. UPTAKE AND TRANSLOCATION: Uptake by seed, roots and hypocotyl with upward translocation to the growing tip. BASIS OF SELECTIVITY: Species differentiation due to enzymatic detoxification and seed food reserves permitting seedling to outgrow effect of chemical. APPLICATION METHODS: Preplant incorporated. To prevent chemical loss, incorporate immediately into the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be to a dry soil surface. RESIDUAL ACTIVITY: Season long weed control with no soil residues the following year to prevent crop rotation. UNIQUE CHARACTERISTICS: Does not need rainfall to activate and will not leach significantly under heavy rainfall. Under unfavourable germination conditions, leaf crinkling or leaf sealing may be observed, but usually without adverse effects on crop yield.

DALAPON. TRADE NAMES: DOWPON, BASFAPON. CHEMICAL FAMILY: Chlorinated aliphatic acid. CROP AND/OR NON-CROP REGISTRATIONS: Potatoes, apples, pears, asparagus, raspberries, grapes (Eastern Canada only), alfalfa, bird's-foot trefoil, peas, flax, rape, sugarbeets, buckwheat and drainage ditches. SENSITIVE WEEDS: Quack grass, most annual grass species, cattails and phragmites. UPTAKE AND TRANSLOCATION: Uptake primarily by the foliage but some root uptake can occur. Translocated within the xylem and phloem. BASIS OF SELECTIVITY: Apparently due to the presence or absence of certain enzymes. APPLICATION METHODS: Postemergence. For quack grass control, if sensitive crops such as cereals, turf, beans or corn are to be planted, application must be made the previous fall; application in spring should be made when quack grass is 10-15 cm high; cultivate 10-14 days later; treatment of mature or dormant quack grass is not effective. No crop except potatoes should be planted within 30 days after spraying. May also be used on land that is summer fallowed. RESIDUAL ACTIVITY: Persists in soil a few weeks. UNIQUE CHARACTERISTICS: Do not graze or feed dalapon-treated grass or foliage to meat or dairy animals during the crop year of application.

DAZOMET. TRADE NAMES: BASAMID, MYLONE. CHEMICAL FAMILY: Dithiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Field and greenhouse vegetable seedbeds for eggplant, lettuce, pepper and tomato; fall treatment only of tobacco greenhouse seedbeds; field and greenhouse seed and planting beds for annual flowers; turf seedbeds. SENSITIVE WEEDS: Most germinating weed seeds. BASIS OF SELECTIVITY: Non-selective. Chemical must be completely dissipated from the seedbed before planting or injury may occur. MODE OF ACTION: Breaks down on contact with soil moisture and releases toxic gases which control germinating weed seeds. APPLICATION METHODS: Apply granular product to a well worked seed bed and incorporate evenly. Seal soil immediately after incorporation by rolling and flooding or by covering with heavy polyethylene plastic and sealing edges. After a waiting period of 10 to 40 days, depending on soil temperature, aerate the soil. Conduct a safety germination test before using treated soil. Do not use when soil temperature is below 6°C. RESIDUAL ACTIVITY: Depends on the rate applied, soil moisture and soil temperature. The gases are toxic to all growing plants and a safety germination test must be carried out to determine that the soil is safe for planting. UNIQUE CHARACTERISTICS: Also controls unencysted nematodes and soil fungi.

DEFOAMERS (See SPRAY ADJUVANT DEFOAMER)

DICAMBA. TRADE NAMES: BANVEL, DYCLEER. CHEMICAL FAMILY: Benzoic acid. CROP AND/OR NON-CROP REGISTRATIONS: Field corn, spring and winter wheat, spring barley, spring rye, oats, summer fallow and stubble, pastures, red fescue, low bush blueberries and turf; non-crop areas such as roadsides, utility rights-of-way, railways and wasteland. SENSITIVE WEEDS: Annual, perennial and biennial broadleaf weeds and numerous brush species including conifers. Particularly effective against velvetleaf, Canada thistle, field bindweed and vari-

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

ous triazine-resistant broadleaf weeds. Control is best when weeds are small and actively growing. UPTAKE AND TRANSLOCATION: Readily absorbed by roots, stems or leaves and then translocated to other plant parts. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Preemergence or postemergence in field corn. For all other crops and non-crop uses, postemergence applications are recommended. RESIDUAL ACTIVITY: Half-life in soil is approximately 30 days. Residue carry-over into the next season is not a problem when applied at rates recommended for crop situations. UNIQUE CHARACTERISTICS: Dicamba is often mixed with grass herbicides or with phenoxy herbicides to provide a broader spectrum of weed control. Spray drift is toxic to sensitive plants in the same manner as 2,4-D; thus similar precautions should be followed. There is also a possibility of dicamba vapor drift from treated plant foliage during high temperatures (in excess of 30°C). At higher rates dicamba can be toxic to trees and shrubs having roots under the treated area. See sections on Herbicide Drift and Reduction of Herbicide Drift.

DICAMBA/ATRAZINE. TRADE NAME: MARKSMAN. CHEMICAL FAMILY: Benzoic acid/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Field corn. SENSITIVE WEEDS: Annual and biennial broadleaf weeds including the triazine-resistant biotypes. APPLICATION METHODS: Postemergence until the standing height of the corn is 13 cm (five leaf stage). UNIQUE CHARACTERISTICS: This mixture provides excellent control of triazine-resistant broadleaf weeds, maintains a low level of triazine for short term residue, and gives improved control of velvetleaf. See also notes on dicamba and atrazine.

DICAMBA/2,4-D. TRADE NAME: DYCLEER 24. CHEMICAL FAMILY: Benzoic acid/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Established turf and non-crop land. SENSITIVE WEEDS: Deciduous and coniferous brush; broadleaf herbaceous weeds. APPLICATION METHODS: Postemergence. UNIQUE CHARACTERISTICS: More effective than 2,4-D alone for control of Canada thistle, bindweed, smartweed and conifers. Has greater soil activity than 2,4-D alone. See also notes on dicamba and 2,4-D.

DICAMBA/MCPA. TRADE NAME: DYVEL. CHEMICAL FAMILY: Benzoic acid/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Barley, spring wheat, winter wheat and oats. UNIQUE CHARACTERISTICS: Provides better control of mustards and hemp-nettle than dicamba alone. See also notes on dicamba and MCPA.

DICAMBA/MCPA/MECOPROP. TRADE NAME: TARGET. CHEMICAL FAMILY: Benzoic acid/phenoxy/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Spring wheat, barley, oats not under-seeded to legumes, stubble fields and summer fallow. SENSITIVE WEEDS: At field crop rates — wild buckwheat, cow cockle, lady's-thumb, green smartweed, mustards, hemp-nettle, Russian thistle, corn spurry, flixweed, annual sow-thistle, shepherd's-purse, common ragweed, pigweeds, chickweed, lamb's-quarters, knotweed, volunteer rapeseed and sunflowers. APPLICATION METHODS: Postemergence when weed seedlings are in the 2 to 3 leaf stage, spring wheat and oats are in the 4 to 5 leaf stage, and barley is in the 2 to 3 leaf stage. Use water carrier and apply at 100 litres total spray mix per hectare. UNIQUE CHARACTERISTICS: This mixture controls a wider spectrum of weeds than any of the herbicide components used alone. Under certain conditions, this mixture may cause shortening of the straw of cereals but yield will not be affected.

DICHLOBENIL. TRADE NAME: CASORON. CHEMICAL FAMILY: Benzonitrile. CROP AND/OR NON-CROP REGISTRATIONS: Cranberries, fruit trees, grapes, highbush blueberries, raspberries, woody nursery stock, shelterbelts and non-crop areas. SENSITIVE WEEDS: Most weeds are susceptible to or suppressed by dichlobenil including perennials, vetch and horsetail. UPTAKE AND TRANSLOCATION: Absorbed by the roots and rapidly translocated upward in the plant. BASIS OF SELECTIVITY: Selectivity is based on physical separation between the dichlobenil vapor layer in the top 5 cm of soil and the established crop roots below this level. APPLICATION METHODS: Applied preemergence to the weeds, preferably in either fall or early spring. RESIDUAL ACTIVITY: May persist and provide weed control for two to six months; higher rates and applications following use in previous year(s) may result in soil residues persisting for longer than one year. UNIQUE CHARACTERISTICS: Although applied as a granular herbicide it kills by means of a vapour phase in the top soil profile. Weed roots take up the herbicide as they enter this zone. Do not apply dichlobenil during periods of high soil temperature since loss of control will result due to volatilization of the herbicide.

2,4-D. TRADE NAMES: Numerous. CHEMICAL FAMILY: Phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Cereals, turf, pastures, non-crop land, asparagus, raspberries, strawberries, water weeds and brush. SENSITIVE WEEDS: Most broadleaf weeds, brush, Eurasian water milfoil, coontail, bladder-wort, water lily and water shield. UPTAKE AND TRANSLOCATION: Readily absorbed through leaves or roots. Translocated primarily in phloem with the sugars but can also move with water in the xylem. Accumulation is primarily in the young rapidly growing meristematic regions of roots or shoots. BASIS OF SELECTIVITY: Differences in interception, penetration, translocation, metabolism and sensitivity of active sites leads to greater activity in broadleaf weeds compared to grasses. APPLICATION METHODS: Postemergence (broadleaf weeds), stem-foliage or stem-basal (brush). RESIDUAL ACTIVITY: Half-life in soil is usually not longer than 1 or 2 weeks during the growing season due to rapid decomposition by soil microorganisms. UNIQUE CHARACTERISTICS: All weeds are more easily killed when growing rapidly in moist soil. Unfortunately some broadleaf crop, garden and ornamental plants are as sensitive to 2,4-D as many weeds and only a trace of the chemical as spray drift, vapor drift or contaminant in soil or water may cause serious damage. Even crops that can be sprayed safely can be sensitive at some stages of growth or at excessive application rates; thus label precautions should be followed carefully. Amines and esters are the most common formulations of 2,4-D. The esters are the most active and can be used at the lower rates and for brush control. Since vapor drift is a potential prob-

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

lem with the ester formulations, only the amines should be used on lawns, or near gardens or susceptible crop areas. Low-volatile esters can be used by agriculturalists or licensed applicators in areas where risk of damage to sensitive non-target vegetation is low. Recommendations are on the basis of acid equivalent. Commercial products differ in their content of acid equivalent and this must be considered in determining the amount of product to use.

2,4-D/DICAMBA/MECOPROP. TRADE NAMES: BANVEL 3, KILLEX, KIL-MOR. CHEMICAL FAMILY: Phenoxy/benzoic acid/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: BANVEL 3 and KIL-MOR for spring wheat, winter wheat, barley, flax, corn, oats, non-crop land; KILLEX for turf. SENSITIVE WEEDS: At field crop rates — wild buckwheat, lady's-thumb, green smartweed, Russian thistle, sow-thistle, hedge bindweed, corn spurry, knotweed, volunteer cultivated buckwheat, common ragweed, cocklebur, stinkweed, mustards, prostrate pigweed, redroot pigweed and lamb's-quarters. At non-crop land rates — a wide range of broadleaf weeds including bull thistle, chicory, goat's-beard, ragwort, white cockle, poison-ivy, alder and sheep-laurel. APPLICATION METHODS: Postemergence when weeds are small and actively growing; see crop recommendations for specific timing. UNIQUE CHARACTERISTICS: This mixture controls a wider spectrum of weeds than any of the herbicides alone.

2,4-DB. TRADE NAMES: EMBUTOX E, COBUTOX. CHEMICAL FAMILY: Phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Seedling alfalfa, bird's-foot trefoil, clovers (except sweet) direct seeded or under seeded in spring wheat, barley or oats; spring wheat, barley and oats; corn. SENSITIVE WEEDS: Many small broadleaf weeds such as stinkweed, ragweed, lamb's-quarters, wild buckwheat and mustards. Top growth control of Canada thistle, field bindweed, and perennial sow-thistle. UPTAKE AND TRANSLOCATION: Absorbed through the foliage and readily translocated to the growing points. BASIS OF SELECTIVITY: Sensitive weeds rapidly convert 2,4-DB into 2,4-D; tolerant species do not make this conversion under normal conditions. APPLICATION METHODS: postemergence. RESIDUAL ACTIVITY: Essentially none. UNIQUE CHARACTERISTICS: Mustards are not usually controlled by 2,4-DB alone if sprayed beyond the four leaf stage; a tank mixture with MCPA will improve control of these larger mustards.

DICHLORPROP/2,4-D. TRADE NAMES: Numerous. CHEMICAL FAMILY: Phenoxy/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Spring and fall wheat and barley; turf; perennial weed and brush control on non-crop land. UNIQUE CHARACTERISTICS: Most properties of dichlorprop are very similar to those of 2,4-D. Chickweed, wild buckwheat, smartweed and some woody species are more sensitive to dichlorprop/2,4-D than to 2,4-D alone. Do not use on oats.

DICLOFOP-METHYL. TRADE NAME: HOEGRASS 284. CHEMICAL FAMILY: Phenoxy-phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Potatoes, white beans, kidney beans, carrots, onions, snap beans, lima beans, wheat, barley, mustard, alfalfa, clover, peas. SENSITIVE WEEDS: Barnyard grass, foxtails, witch grass, fall panicum, wild oats, volunteer corn. UPTAKE AND TRANSLOCATION: Primarily through the leaves. Does not translocate significantly. BASIS OF SELECTIVITY: Differential metabolism by tolerant vs sensitive species. APPLICATION METHODS: Postemergence when grass weeds are in the 1 to 4 leaf stage. RESIDUAL ACTIVITY: Essential none. UNIQUE CHARACTERISTICS: Tank mixtures with broadleaf herbicides will result in reduced weed control. A time interval of 4 days before or after an application of diclofop-methyl is required.

DIFENZOQUAT. TRADE NAME: AVENGE. CHEMICAL FAMILY: Quaternary ammonium. CROP AND/OR NON-CROP REGISTRATIONS: Barley; spring wheat (Neepawa, Glenlea, Selkirk, Chester, Macoun, Canuck, Benito, Columbus, Fielder and Leader cultivars only); triticale (Welsh and Carmen); winter wheat (Norstar and Sundance); fall rye (Cougar, Puma, Frontier, Rymin and Kodiak); canary grass; forages underseeded to barley or wheat. SENSITIVE WEEDS: wild oats (tame oats also killed). UPTAKE AND TRANSLOCATION: Readily absorbed by foliage. Not translocated. BASIS OF SELECTIVITY: Not established. APPLICATION METHODS: Postemergence to actively growing wild oats at the 3 to 5 leaf stage. Do not apply to plants that are wet with dew or rain, or if rain is expected within 6 hours. RESIDUAL ACTIVITY: Essentially none. UNIQUE CHARACTERISTICS: The lower leaves of barley can be injured if cool weather conditions are present at the time of spraying or up to 2 days after. Frost or temperatures within 2 degrees of frost will accentuate this injury. This injury is usually temporary and does not reduce barley yield. See label for registered tank mixes.

DINOSEB. TRADE NAME: POTATO TOP KILLER. CHEMICAL FAMILY: Phenol. CROP AND/OR NON-CROP REGISTRATIONS: Preharvest spraying to facilitate harvest of soybean seed crops. SENSITIVE WEEDS: Most annual broadleaf weeds and grasses; top growth control of perennial herbaceous broadleaf weeds and grasses. UPTAKE AND TRANSLOCATION: Primarily foliar contact activity resulting in cell necrosis. No true translocation. BASIS OF SELECTIVITY: Non-selective. APPLICATION METHODS: Postemergence. RESIDUAL ACTIVITY: Essentially none. UNIQUE CHARACTERISTICS: Readily absorbed through the skin; highly toxic; skin sensitizer.

DIPHENAMID. TRADE NAME: ENIDE. CHEMICAL FAMILY: Substituted acetamide. CROP AND/OR NON-CROP REGISTRATIONS: Tobacco, tomatoes, strawberries, peppers, woody nursery stock. SENSITIVE WEEDS: Crab grass, barnyard grass, goose grass, stink grass, foxtail, cheat, pigweed, lamb's-quarters, carpetweed, smartweed and knotweed. UPTAKE AND TRANSLOCATION: Absorbed through roots of germinating weeds. Translocated throughout seedling. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Preemergence to weeds as either a broadcast or band treatment. Must be moved into the top few cm of soil by rainfall, overhead irrigation or mechanical incorporation to 1.25-5 cm depth. Deeper incorporation may result in poor weed control. RESIDUAL ACTIVITY: Under warm, moist conditions, from 3 to 6 months; under dry con-

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

ditions, 10 to 11 months. UNIQUE CHARACTERISTICS: Edible crops, other than those registered for use with diphenamid, should not be planted in diphenamid-treated soil for six months after last application. Small grain cover crops sown within six months of diphenamid application may be injured.

DIQUAT. TRADE NAME: REGLONE. CHEMICAL FAMILY: Bipyridylium. CROP REGISTRATIONS: Dessication of rapeseed, flax, dry beans, dry peas, mustard, sunflowers, soybeans, adzuki beans, legume seed crops. Vine killing of potatoes. Control of corn spurry in oats. Stale seedbed and inter row weeding. SENSITIVE WEEDS: Any foliage contacted by diquat will be killed. UPTAKE AND TRANSLOCATION: Rapidly absorbed by foliage. Limited translocation. BASIS OF SELECTIVITY: None. APPLICATION METHODS: Postemergence. RESIDUAL ACTIVITY: Essentially none due to adsorption of chemical to soil particles. UNIQUE CHARACTERISTICS: Must be used with clean (non-turbid) water as the soil particles in muddy water drastically reduce the effectiveness of diquat.

DIQUAT. TRADE NAME: REGLONE A. CHEMICAL FAMILY: Bipyridylium. NON-CROP REGISTRATIONS: Aquatic weed control in still or flowing water in ponds, ditches, lakes and canals. SENSITIVE WEEDS: Coontail, Canada water weed, pondweeds, milfoil and duckweed. UPTAKE AND TRANSLOCATION: Contact dessicant with limited translocation. BASIS OF SELECTIVITY: None. APPLICATION METHODS: Postemergence. Apply when weeds are visible and are actively growing. It can be applied: with a boat bailer device which injects the chemical below the water surface; sprayed over the water surface; or poured directly from a container onto the surface. RESIDUAL ACTIVITY: Quickly inactivated by adsorption to soil particles. UNIQUE CHARACTERISTICS: Must be used with and applied on non-turbid water, as the soil particles in muddy water drastically reduce the effectiveness of the material. Apply at dusk. Do not use treated water for swimming or consumption by humans or animals for at least 24 hours. Do not use water for irrigation for five days after treatment. To avoid fish kills caused by oxygen depletion, treat only 1/4 to 1/3 of the area at a time. Avoid application or drift onto crops, lawns, grazing areas, ornamental plants and other desirable plants.

DIURON. TRADE NAME: KARMEX. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Grapes, asparagus, gladioli, industrial sites, right-of-ways. SENSITIVE WEEDS: Annual and perennial grasses, pigweed, ragweed, wild carrot, and dandelion. Perennial weed control at higher rates in non-crop areas. UPTAKE AND TRANSLOCATION: Most readily absorbed by roots, less so by foliage. Translocated upward in the xylem. BASIS OF SELECTIVITY: Used only in deep rooted crops that are well-established. APPLICATION METHODS: Applied to crops as a preemergence or directed early postemergence spray, preferably before weed growth becomes dense. Better control of emerged weeds is obtained by the addition of a suitable surfactant. In non-crop areas, diuron may be sprayed anytime except when ground is frozen. RESIDUAL ACTIVITY: At lower rates used in crops, residues last about a year, and thus applications may be repeated annually. At higher non-crop rates, persistence may be more than one year. UNIQUE CHARACTERISTICS: Should not used where it is likely to leach or wash into contact with the roots of desirable trees or shrubs.

DRIFT CONTROL AGENTS (see BIVERT PH, NORBAK, NALCO-TROL)

EPTC. TRADE NAME: EPTAM. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Alfalfa, bird's-foot trefoil, snap or dry beans (including kidney), flax, potatoes, sunflowers, woody nursery stock and annual flowers. SENSITIVE WEEDS: Annual grasses such as crab grass, barnyard grass, fall panicum, wild oats, green foxtail and yellow foxtail; yellow nutsedge; some annual broadleaf weeds such as corn spurry, lamb's-quarters, nightshade, pigweed and chickweed if conditions are favourable for germination and growth. UPTAKE AND TRANSLOCATION: Uptake by underground plant parts (roots, hypocotyl and seed). Upward translocation to the growing tip. BASIS OF SELECTIVITY: Metabolized by tolerant species at the seed germination stage through enzymatic breakdown of the chemical. Seed food reserves also permit seedling to outgrow chemical effect. APPLICATION METHODS: Preplant incorporated or postplant incorporated. May be applied using water or liquid fertilizers as the carrier. Dry fertilizers may also be used as a carrier when impregnated by licensed fertilizer dealers. To prevent chemical loss and reduced weed control, EPTC should be uniformly incorporated in the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be to a dry soil surface. RESIDUAL ACTIVITY: Applied in the spring preplant, EPTC provides season-long weed control with no soil residues the following year to prevent crop rotation. UNIQUE CHARACTERISTICS: EPTC does not need rainfall to activate and will not leach significantly under heavy rainfall. Under unfavourable germination conditions, leaf crinkling or leaf sealing may be observed on certain crops but usually without adverse effects on yield. May be tank-mixed with metribuzin for additional broadleaf weed control in potatoes. See label for other tank mix combinations and information on less conventional methods of application.

EPTC/R25788 (EPTC+). TRADE NAME: ERADICANE. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field and sweet). SENSITIVE WEEDS: Annual grasses such as wild oats, crab grass, barnyard grass, foxtails, fall panicum; suppression of wild proso millet; yellow nutsedge, horsetail and some annual broadleaf weeds when conditions are favourable for germination and growth. UPTAKE AND TRANSLOCATION: Uptake by underground plant parts (roots, hypocotyl and seed) then upward translocation to the growing tip. BASIS OF SELECTIVITY: Metabolized by tolerant species at the seed germination stage through breakdown of the chemical. R25788 enhances the enzymatic breakdown of the chemical in tolerant species. Also, seed food reserves permit corn seedlings to outgrow chemical effect. APPLICATION METHODS: EPTC/R25788 may be applied using water or liquid fertilizers as the carrier. Dry

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

fertilizers may also be used as a carrier when impregnated by licensed fertilizer dealers. To prevent chemical loss and reduced weed control, EPTC/R25788 should be uniformly incorporated into the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are done in separate operations, application should be to a dry soil surface. Preplant incorporated may be used in tank-mix combination with atrazine for additional broadleaf weed control. RESIDUAL ACTIVITY: Provides season long weed control with no soil residues the following year to prevent crop rotation. In tank-mix combinations with atrazine, there may be atrazine residues when the highest atrazine rate is used. UNIQUE CHARACTERISTICS: EPTC/R25788 does not need rainfall to be activated and will not leach significantly under heavy rainfall.

FLAMPROP-METHYL. TRADE NAME: MATAVEN. CHEMICAL FAMILY: Acetanilide. CROP AND/OR NON-CROP REGISTRATIONS: Wheat, triticale, canary grass, sunflower and certain forage crops. SENSITIVE WEEDS: Wild oats. UPTAKE AND TRANSLOCATION: Absorbed through the leaves. Translocated in the phloem to the stem. BASIS OF SELECTIVITY: Tolerant species metabolize the herbicide faster than wild oats. APPLICATION METHODS: Postemergence. Apply when wild oats are in the 3 to 6 leaf stage. RESIDUAL ACTIVITY: Although the half-life in soil is from 1 to 3 weeks there is very little soil activity. UNIQUE CHARACTERISTICS: Rainfall within 2 hours of application will reduce effectiveness. Common oats are also killed by this herbicide.

FOSAMINE AMMONIUM. TRADE NAME: KRENITE. CHEMICAL FAMILY: Carbamoyl phosphonate. CROP AND/OR NON-CROP REGISTRATIONS: Vine and brush control on non-crop land. SENSITIVE WEEDS: Control and growth suppression of blackberry, oak, pine, sumac, maple, elder, elm, wild rose, hazel, aspen and beech. Cedar and spruce are quite tolerant. UPTAKE AND TRANSLOCATION: Absorption by young stems and foliage. Translocation has been observed from a treated mature leaf to all other parts of a plant but phloem transport with sugars is predominant. BASIS OF SELECTIVITY: Not highly selective. APPLICATION METHODS: Postemergence. Apply in high pressure ground equipment to ensure penetration of spray to thoroughly wet leaves, buds, stems and trunks of target brush. Surfactants are recommended to promote rapid leaf penetration. RESIDUAL ACTIVITY: Essentially none. UNIQUE CHARACTERISTICS: Woody plants treated with fosamine ammonium die very slowly; the stems may not be completely killed 2 years after treatment; the unsightly brown-out effect common to many other herbicides does not occur. Rainfall within 24 hours of application may decrease effectiveness.

FRIGATE. TYPE OF ADJUVANT: Cationic surfactant. CHEMICAL COMPOSITION: Mixture of ethoxylated long-chain fatty amines. REGISTERED USES: Season-long control of quack grass at the lower rate of glyphosate (0.9 kg/ha). BENEFIT: More consistent season-long control of quack grass at low rate of glyphosate. MODE OF ACTION: Improves wetting of foliage and enhances uptake of glyphosate. MIXING: Add glyphosate to the required amount of water in the spray tank under agitation; then add FRIGATE at 0.5 litres per 100 litres of spray mix. When water temperature is less than 5°C, premix FRIGATE with an equal volume of warm water before adding to spray tank.

FUMIGANTS (see METAM SODIUM, METHYL BROMIDE/CHLOROPICRIN, METHYL ISOTHIOCYANATE/DICHLOROPROPENE, METHYL ISOTHIOCYANATE/DICHLOROPROPENE/CHLOROPICRIN)

GLYPHOSATE. TRADE NAME: ROUNDUP. CHEMICAL FAMILY: N-(phosphonomethyl) glycine. CROP AND/OR NON-CROP REGISTRATIONS: Preplant or post-crop with no cropping restrictions; brush control; silvicultural site preparation and conifer release; directed application in woody nursery stock, shelter belts, grapes, apples, pears and peaches. SENSITIVE WEEDS: Annual grasses; perennial weeds (quack grass, Canada thistle, field bindweed, milkweed, cattails, nutsedge, poison-ivy and strawberry); brush (birch, alder, poplar, raspberry, willow and maple). UPTAKE AND TRANSLOCATION: Absorbed through foliage and translocated throughout the plant. BASIS OF SELECTIVITY: Non-selective for agricultural crops. Conifers are tolerant but the basis has not been established. APPLICATION METHODS: Postemergence, usually at the prebloom stage of growth for most perennial weeds. Canada thistle should be at least in early flower bud, milkweed at flower bud, and bindweed at full flower. Quack grass can be treated in the spring or fall when it is actively growing with at least 4 new leaves on each emerged shoot; in the fall, remove crop refuse but do not till prior to application; fall or spring tillage prior to spring application may reduce control; wait at least 5 days after application before working the area; for maximum control it is advisable to till before the quack grass turns completely brown. Glyphosate can be applied with boom equipment, knapsack sprayers and high volume equipment for agricultural and non-crop uses. Backpack mist blowers may be used for silvicultural site preparation and roadside brush control only. Aerial applications may be used for silvicultural site preparation and conifer release only. Can also be applied with selective equipment for non-crop areas, tree plantings, grapes and orchards (See sections entitled "Special Methods of Weed Control" and "Selective Weed Control with Wiper Applicators"). Regardless of method of application, do not allow herbicide solution to contact green foliage or green bark of crop or other desirable plants; remove all suckers from the trunks of desirable trees before spraying. RESIDUAL ACTIVITY: None; crops can be planted or seeded directly into treated areas following application. Other herbicides are required to control weeds emerging after the application. UNIQUE CHARACTERISTICS: Rainfall within 6 hours after application or heavy frost may reduce control.

HERBICIDAL OIL (see MINERAL OIL [HERBICIDAL])

HEXAZINONE. TRADE NAME: VELPAR. CHEMICAL FAMILY: Triazine. CROP AND/OR NON-CROP REGISTRATIONS: Alfalfa, Christmas trees, coniferous reforestation, non-crop land. SENSITIVE WEEDS: Most herbaceous broadleaf weeds and grasses including raspberry, bluejoint grass, goldenrod and brome grass; spot applications control aspen, ash, maple, cherry and birch. UPTAKE

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

AND TRANSLOCATION: Absorbed through roots and foliage; translocation is primarily upwards through xylem. BASIS OF SELECTIVITY: Tolerant species metabolize hexazinone faster than sensitive species. For conifers, at least part of the selectivity is due to the trees' roots being deeper than hexazinone leaches into the soil. APPLICATION METHODS: For broadcast applications, apply preemergence or as a postemergence foliar spray during active plant growth. For spot applications, use a spot gun to apply undiluted VELPAR-L as close as possible to the root collar of plants to be controlled; keep spots at least one metre away from desirable conifers. RESIDUAL ACTIVITY: Half-life of two months on a Flanagan silt loam in Illinois. Half-life of two and one half months on a silty clay in northern Ontario. UNIQUE CHARACTERISTICS: Rainfall is needed to activate hexazinone in the soil. Do not use on gravelly or rocky soils, or on frozen ground. Do not apply to areas where the roots of desirable trees may extend. Liquid formulation is flammable.

KORNOIL. TYPE OF ADJUVANT: Mineral oil (non-herbicidal). CHEMICAL COMPOSITION: 98.5% mineral oil, 1.5% emulsifier. REGISTERED USES (CROP/HERBICIDE): Corn/atrazine. BENEFIT: Improved postemergence activity of atrazine, especially on quack grass, yellow nutsedge and annual grasses. MODE OF ACTION: Partially dissolves waxy cuticle of weeds allowing atrazine to penetrate more readily. MIXING: Fill spray tank with water allowing space for subsequent addition of atrazine and oil; engage agitation and pour in premixed slurry of atrazine in water; add KORNOIL last. Avoid excessive agitation of the spray mix as this may cause coagulation or buttering out. UNIQUE CHARACTERISTICS: To prevent a buildup of oil in the sprayer, empty the tank as completely as possible before refilling. Some injury may occur if the crop is stressed (cold, backward weather or hot, dry weather).

KORNOIL CONCENTRATE. TYPE OF ADJUVANT: Mineral oil/surfactant (non-herbicidal). CHEMICAL COMPOSITION: Paraffin base mineral oil 85%, surfactant blend 15%. REGISTERED USES: To be blended with atrazine/water mixtures and applied postemergence in corn. BENEFIT: Improved postemergence activity of atrazine, especially on quack grass, yellow nutsedge and annual grasses. MODE OF ACTION: Partially dissolves waxy cuticle of weeds allowing atrazine to penetrate more readily. Also reduces evaporation and aids in spreading of spray droplets on the leaf surface leading to a longer period for penetration. MIXING: Avoid violent agitation; partially fill sprayer, add atrazine slurry, add KORNOIL CONCENTRATE last. UNIQUE CHARACTERISTICS: Some injury may occur with cold, rainy, backward weather.

LINURON. TRADE NAMES: LOROX, AFOLAN. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Corn, soybeans, carrots, celery, dill, parsnips, potatoes, asparagus, wheat, oats, barley, gladioli, fruit trees. SENSITIVE WEEDS: Annual weeds such as barnyard grass, common chickweed, corn spurry, crab grass, velvetleaf, fall panicum, foxtail, goosefoot, goose grass, groundsel, knotweed, lamb's-quarters, redroot pigweed, purslane, common ragweed, shepherd's-purse, smartweed, stinkweed, wild buckwheat, witch grass, wormseed mustard; seedlings only of dandelion, plantain and sow-thistle. UPTAKE AND TRANSLOCATION: Readily absorbed through roots, less so through foliage; translocation primarily upwards in xylem. BASIS OF SELECTIVITY: Differential metabolism, often coupled with differential uptake and translocation. APPLICATION METHODS: Preemergence, postemergence, directed postemergence, pre plus postemergence. RESIDUAL ACTIVITY: Does not pose a problem for subsequent crops since phytotoxic residues from applications at agricultural rates disappear within four months. UNIQUE CHARACTERISTICS: Do not use on sandy or coarse-textured soils having less than 2% organic matter. If unusually heavy rains follow application, severe injury may occur to corn, soybeans, carrots and potatoes.

MALEIC HYDRAZIDE. TRADE NAME: ROYAL MH 60 SG. CHEMICAL FAMILY: Unique. CROP AND/OR NON-CROP REGISTRATIONS: Growth control in lawns, turf, trees and shrubs. Sprout control in stored beets, carrots, onions, potatoes and rutabagas. SENSITIVE WEEDS: Controls the growth of wild onion, garlic, and biennial type weeds such as dandelion and plantain when applied in the fall. UPTAKE AND TRANSLOCATION: Absorbed through foliage. Translocated to active growing points in plant. Translocated more effectively downwards. BASIS OF SELECTIVITY: Not established. APPLICATION METHODS: Postemergence. Use as a foliar spray. Dosage and stage of plant development are critical factors. To reduce or eliminate mowing, apply in the spring or fall to green non-dormant grass; can be mixed with 2,4-D for spring applications. For tree and shrub growth control apply to the portion of the plant on which growth is to be inhibited; growth control is best when applied to vigorous new growth; spray leaves and bark to point of drip. RESIDUAL ACTIVITY: None. UNIQUE CHARACTERISTICS: Do not apply on or near crops being grown for seed. Rain within 24 hours after application will reduce effectiveness. Since temporary discoloration of grass may result, this chemical is recommended for use in areas where mowing grass is difficult and where lawn-like appearance is not necessary.

MCPA. TRADE NAMES: Numerous. CHEMICAL FAMILY: Phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Cereal crops, turf, non-crop sites. SENSITIVE WEEDS: Many broadleaf weeds, especially buttercup, hemp-nettle, field horsetail (top growth only), seedling dock. UPTAKE AND TRANSLOCATION: Absorbed through leaves or roots. Translocates to, and accumulates at, growing points of shoots and roots. BASIS OF SELECTIVITY: Differences in interception, penetration, translocation, metabolism and sensitivity of active sites leads to greater activity in broadleaf weeds than grasses. APPLICATION METHODS: Postemergence. RESIDUAL ACTIVITY: Some soil residues can be detected for up to one month under moist conditions and two months under drier conditions. UNIQUE CHARACTERISTICS: MCPA is available in three different formulations (potassium or sodium salt, amine and ester). It is safer than 2,4-D for use on oats, flax and peas. As with 2,4-D, there is a potential drift hazard to nearby susceptible crops such as grapes, turnips, tobacco and cabbage.

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

MCPA/MCPB. TRADE NAME: TROPOTOX PLUS. CHEMICAL FAMILY: Phenoxy/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Seedling white, ladino, alsike or red clovers direct seeded or underseeded in wheat, oats, barley, rye; pastures; field corn; peas; apples. SENSITIVE WEEDS: Small emerged mustards, stinkweed, ragweed, lamb's-quarters, redroot pigweed, shepherd's-purse, volunteer rapeseed, wild radish, hemp-nettle, annual sow-thistle; top growth control of bull thistle, Canada thistle, curled dock, plantain, perennial sow-thistle, field bindweed, horsetail and buttercup. APPLICATION METHODS: Postemergence. In cereals, clovers and peas, apply as an overall spray. In corn apply with drop pipes after the corn reaches 45 cm before the beginning of tasselling. Apply to pastures after grazing or cutting.

MCPB. TRADE NAME: TROPOTOX. CHEMICAL FAMILY: Phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Peas and apples. SENSITIVE WEEDS: Annual broadleaf weeds including wild mustard, wormseed mustard, stinkweed, ragweed, redroot pigweed and lamb's-quarters. Topgrowth control of Canada thistle, bull thistle, perennial sow-thistle and field bindweed. UPTAKE AND TRANSLOCATION: Absorbed through the foliage and readily translocated, especially to the growing points. BASIS OF SELECTIVITY: MCPB is not directly toxic to plants. Susceptible weeds convert MCPB to MCPA. Peas do not make this conversion. APPLICATION METHODS: Postemergence when weeds are small and actively growing. Apply when peas have 3 to 6 expanded leaves. Apply to apples as a directed spray under established trees; avoid contact with leaves, fruit, young growing shoots, suckers and green bark of apple trees. RESIDUAL ACTIVITY: Essentially none. UNIQUE CHARACTERISTICS: Applications made in less than 150 L/ha of water or when peas are past the 6 leaf stage or when peas are stressed (drought, disease) may result in crop damage.

MECOPROP. TRADE NAMES: MECOTURF, COMPITOX. CHEMICAL FAMILY: Phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: COMPITOX — turf. MECOTURF — lawns, turf, wheat, oats and barley. SENSITIVE WEEDS: Many broadleaf weeds such as chickweed, cleavers, plantain, clover, corn spurry, stichwort, black medick, knotweed, shepherd's-purse, buttercup, Canada thistle (top growth control) and dandelion. For complete control of Canada thistle, dandelion and black medick a repeat application will likely be required. UPTAKE AND TRANSLOCATION: Absorbed readily by foliage and translocated to roots and throughout shoots, especially to growing points. BASIS OF SELECTIVITY: Differences in interception, penetration, translocation, metabolism and sensitivity of active sites result in broadleaf species being more sensitive than grasses. APPLICATION METHODS: Postemergence. Apply to cereals between the 3 leaf and early flag leaf stage. In lawns and turf apply when weeds are actively growing (May, June and September). RESIDUAL ACTIVITY: Can persist in soil up to 4 weeks, however, grass can normally be seeded within 1 to 2 weeks after treatment. UNIQUE CHARACTERISTICS: Controls 2,4-D resistant weeds such as chickweed, clovers, black medick and young knotweed. Do not spray on grain underseeded to legumes. If cereals are stressed at the time of application, deformed heads and missing florets may result. Can be safely used on bent grass; however, injury may occur if temperature is above 27°C. Effectiveness will be reduced if rain occurs within 4-6 hours after treatment.

METAM SODIUM. TRADE NAME: VAPAM. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Field and greenhouse seedbeds. Field replant sites of fruits, vegetables, tobacco, ornamentals and forest tree stock. SENSITIVE WEEDS: Most scarified weed seeds and fleshy vegetative parts including rhizomes and germinating seedlings. MODE OF ACTION: With moisture, methyl isothiocyanate gas is released which kills most scarified seeds and fleshy vegetative parts including rhizomes and germinating seedlings. BASIS OF SELECTIVITY: Most plant parts are sensitive. Crops are not planted until all fumigant has dissipated from the soil. APPLICATION METHODS: Apply uniformly using injectors, water or other incorporation tools to carry the product to the desired soil depth. May be applied via the irrigation system. No gas-proof cover is required unless the soil is very porous; however, a sprinkler application of water should be used to provide a surface 'water seal'. RESIDUAL ACTIVITY: Ten to forty days depending on soil temperature and the amount of organic matter present in the soil. Persistence is greatest at low temperatures and high levels of organic matter. Planting may take place 12 to 16 days after the treatment and following a lettuce seedling bioassay that indicates no injury. UNIQUE CHARACTERISTICS: Also controls nematodes, soil fungi and soil insects. All traces of toxic gases must be dissipated from the treated soil before planting or plant injury may occur.

METHYL BROMIDE/CHLOROPICRIN. TRADE NAMES: TERR-O-GAS. CHEMICAL FAMILY: Organohalogen. CROP AND/OR NON-CROP REGISTRATIONS: Greenhouse and tobacco seedbeds. Methyl bromide is very poisonous to man and livestock; only an experienced operator should attempt its use. SENSITIVE WEEDS: Germinating seedlings. MODE OF ACTION: Gas is toxic to germinating seedlings. APPLICATION METHODS: Formulated as a liquid under pressure which, when released from the container, forms a gas. Soil must be sealed with a plastic sheet since the gas is highly volatile. Refer to label for detailed directions. UNIQUE CHARACTERISTICS: Methyl bromide gas is highly volatile, and highly poisonous to humans and livestock. It may be absorbed by inhalation, ingestion and dermal contact. A permit must be obtained from the Ontario Ministry of the Environment each time it is used. Also controls soil insects, nematodes and fungus diseases.

METHYL ISOTHIOCYANATE/DICHLOROPROPENE. TRADE NAME: VORLEX PLUS LIQUID SOIL FUMIGANT. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Preplant treatment in both field and greenhouse soils to be planted to: ornamental plants such as flowers and evergreens; vegetables such as celery, lettuce, beets, tomatoes, eggplant, beans, melons, onions, asparagus and squash; field crops such as tobacco, sugar beets, potatoes, ginseng; small fruits such as strawberries. SENSITIVE WEEDS: All growing weed seedlings within the fumigated zone. Non-germinated seeds or established weeds may not be controlled. BASIS OF SELECTIVITY: Non-selective. MODE OF ACTION: Gas is toxic to most young, green plant tissues. APPLICATION METHODS: Injected into the soil 15 to

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

20 cm deep using special application equipment. The soil surface is sealed by either surface irrigation or physically compacting the soil surface. Cultivation of the fumigated soil after the desired period of time allows the gas to escape. RESIDUAL ACTIVITY: Varies with soil type but usually 4 to 6 weeks if left undisturbed. Always check the soil for fumigant using the lettuce germination test before planting a crop in it. UNIQUE CHARACTERISTICS: Also controls fungal diseases and unencysted nematodes.

METHYL ISOTHIOCYANATE/DICHLOROPROPENE/CHLOROPICRIN. TRADE NAME: VORLEX PLUS CP LIQUID SOIL FUMIGANT. UNIQUE CHARACTERISTICS: Chloropicrin provides added disease control to the mixture. See notes on previous chemical.

METOBROMURON. TRADE NAME: PATORAN. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: soybeans, dry common beans (kidney, white, yellow-eye), lima beans, snap common beans, adzuki beans, potatoes. SENSITIVE WEEDS: Annual broadleaf weeds (including triazine-resistant strains) such as pigweeds, lamb's-quarters, green smartweed, ragweed, lady's-thumb, shepherd's-purse, black nightshade, cudweed, corn spurry, groundsel, purslane, chickweed, mustards and stinkweed. Some activity on annual grasses such as barnyard grass, crab grass, green foxtail, witch grass, annual bluegrass and stink grass. The annual grasses are the first to escape treatment. UPTAKE AND TRANSLOCATION: Absorbed through the roots. Translocated in the transpiration stream to the leaves where it accumulates at the margins. BASIS OF SELECTIVITY: Achieved through differential interception of the herbicide. Metobromuron must be placed on the soil surface and move into the zone of germinating weed seeds but not come in contact with the roots of the germinating crop plants. APPLICATION METHODS: Preemergence. For beans apply before the beans and weeds emerge; beans should be planted 4-5 cm deep; shallow planted crops may be injured; do not use on soils with less than 2% organic matter; optimum organic levels are 2-5%. For potatoes, metobromuron should be applied at ground crack after the first hilling, provided the soil completely covers the emerged potato tips. RESIDUAL ACTIVITY: Relatively short (6-8 weeks). UNIQUE CHARACTERISTICS: Moisture is required for distribution into the top layer of soil where weed seeds are germinating. Soil residues do not carry over to affect subsequent crop rotations.

METOBROMURON/METOLACHLOR. TRADE NAME: GALEX. CHEMICAL FAMILY: Substituted urea/acetanilide. CROP AND/OR NON-CROP REGISTRATIONS: Soybeans. SENSITIVE WEEDS: Annual grasses including green, yellow and giant foxtail, smooth and hairy crab grass, barnyard grass, fall panicum, witch grass and annual blue grass. Broadleaf weeds including pigweed, lamb's-quarters, green smartweed, lady's-thumb, ragweed, shepherd's-purse, nightshade, cudweed, corn spurry, groundsel, purslane, chickweed, mustards and stinkweed. BASIS OF SELECTIVITY: Soybeans are planted deep enough that the chemical does not come in contact with the germinating seedlings. If beans are planted too shallow, injury will result. APPLICATION METHODS: Preemergence as an overall spray or banded over the crop row. RESIDUAL ACTIVITY: Winter cereals may be planted 4.5 months following application. UNIQUE CHARACTERISTICS: Mixture provides control of a wider spectrum of weeds than either component (metobromuron is more effective on broadleaf weeds and metolachlor is more effective on grasses). Optimum results are obtained when adequate rainfall occurs within 10 days after application. Do not use on muck or high organic soils, or coarse textured soils low in organic matter. See also notes on metobromuron and metolachlor.

METOLACHLOR. TRADE NAME: DUAL. CHEMICAL FAMILY: Acetanilide. CROP AND/OR NON-CROP REGISTRATIONS: Corn, soybeans, snap beans (yellow and green only), dry beans (white, kidney and pinto only), lima beans, potatoes, sugar beets and rutabagas. SENSITIVE WEEDS: Large and smooth crab grass; witch grass; barnyard grass; fall panicum; giant, green and yellow foxtail; yellow nutsedge. UPTAKE AND TRANSLOCATION: Absorbed by germinating grasses mainly through shoot just above seed. Absorbed by germinating broadleaf weeds by roots and shoots. BASIS OF SELECTIVITY: Not established. APPLICATION METHODS: Preplant incorporated and preemergence. Early postemergence on corn (spike to two leaf stage of corn). Incorporation equipment should be set to work the soil 10 cm deep with a disc operating at 6-10 km/hr or a vibrating shank cultivator at 10-13 km/hr; one incorporation is sufficient and need not be immediate. Rainfall within 10 days is required for maximum activity of the preemergence application. RESIDUAL ACTIVITY: Activity will normally be maintained for 10-14 weeks. UNIQUE CHARACTERISTICS: The rate required depends on weed pressure (higher rate for heavier weed pressure). Yellow nutsedge control requires a preplant incorporated application. Winter cereals may be planted 4.5 months after metolachlor application. Many tank mix combinations are registered on various crops. Do not use on muck soils or coarse textured soils low in organic matter.

METOLACHLOR/ATRAZINE. TRADE NAME: PRIMEXTRA. CHEMICAL FAMILY: Acetanilide/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Corn (ensilage, field, seed and sweet). SENSITIVE WEEDS: Germinating annual broadleaf weeds and annual grasses such as American nightshade, lady's-thumb, lamb's-quarters, wild mustard, purslane, prostrate pigweed, redroot pigweed, wild buckwheat, smartweed, ragweed, crab grass, barnyard grass, green foxtail, yellow foxtail, giant foxtail, witch grass and fall panicum. Yellow nutsedge can be controlled with a preplant incorporated application. UPTAKE AND TRANSLOCATION: Mainly root uptake, with a small amount of shoot absorption. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Preplant incorporated, preplant, preemergence and early postemergence (spike to 2 leaf). One incorporation is sufficient and need not be immediate. Incorporation equipment should be set to work the soil 10 cm deep with a disc operating at 6-10 km/hr or a vibrating shank cultivator at 10-13 km/hr. Rainfall within 10 days is required for maximum activity of the preemergence application. Metolachlor/atrazine may be applied in liquid fertilizers for preplant incorporated or preemergence weed control. Dry bulk granular fertilizers may be impregnated with metolachlor/atrazine for preplant incorporation. RESID-

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

UAL ACTIVITY: Activity will normally be maintained for 10-14 weeks; late germinating velvetleaf and fall panicum will not be controlled. Soybeans, white beans, oats, or barley may be planted the following spring. UNIQUE CHARACTERISTICS: Will not control triazine-resistant weed species. Contains atrazine in low amounts which may carry over in a dry year. Is effective over a wide range of soil types and has a good margin of crop safety. Perennial weeds are not controlled.

METRIBUZIN. TRADE NAMES: LEXONE, SENCOR. CHEMICAL FAMILY: Triazine. CROP AND/OR NON-CROP REGISTRATIONS: Established asparagus, faba beans, potatoes, soybeans, transplant tomatoes and triazine resistant canola. SENSITIVE WEEDS: Lamb's-quarters, wild mustard, redroot pigweed, common ragweed, shepherd's-purse, lady's-thumb, velvetleaf, jimsonweed, prostrate pigweed, Russian thistle, yellow wood-sorrel, prickly mallow, chickweed, cocklebur, carpetweed, dandelion seedlings, barnyard grass, crab grass, foxtail, fall panicum, witch grass, Johnson grass seedlings and cheat grass. UPTAKE AND TRANSLOCATION: Some uptake through the foliage but the major route is via the roots. Translocation upwards in the xylem. BASIS OF SELECTIVITY: Degradation by tolerant species. APPLICATION METHODS: Preplant incorporated (potatoes, soybeans, tomatoes and triazine resistant canola); preemergence (asparagus, potatoes, soybeans and triazine resistant canola); postemergence (potatoes, tomatoes and triazine resistant canola). RESIDUAL ACTIVITY: Varies with the climate. At normal use rates the half-life is one to two months. UNIQUE CHARACTERISTICS: Heavy rainfall following application may cause crop damage. Some varieties of potato, soybean and tomato are less tolerant than others. Triazine-resistant weeds are not controlled. Do not use on muck soils.

MINERAL OIL (HERBICIDAL). TRADE NAMES: WEED KILLER 350, AGRICULTURAL WEED KILLER NO. 1. CHEMICAL FAMILY: Aliphatic and aromatic hydrocarbons. CROP AND/OR NON-CROP REGISTRATIONS: Carrot, celery, dill, parsley, parnsips. SENSITIVE WEEDS: Annual weeds with the exception of ragweed, wormwood and wild carrot. UPTAKE AND TRANSLOCATION: Absorbed by foliage. Little or no translocation. BASIS OF SELECTIVITY: Low interception species like the Umbelliferae family are tolerant. APPLICATION METHODS: Postemergence; broadcast or banded. For carrots, dill, parsley and parsnips, apply as soon as true leaves develop and before roots are thicker than a pencil. For celery apply as soon as true leaves develop. Weeds should be less than 10 cm tall. Best results will be obtained if spray is applied on cool sunny mornings; do not apply when excessively hot. RESIDUAL ACTIVITY: None. UNIQUE CHARACTERISTICS: Do not apply within 30 days of harvest as late applications may flavor the harvested crop.

MINERAL OIL (NON-HERBICIDAL) (see KORNOIL)

MINERAL OIL/SURFACTANT (NON-HERBICIDAL) (see ASSIST OIL CONCENTRATE, KORNOIL CONCENTRATE)

MONOLINURON. TRADE NAME: AFESIN. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Soybeans, white beans, yellow-eye beans, kidney beans, lima beans, snap beans, potatoes. SENSITIVE WEEDS: Particularly effective on most annual broadleaf weeds including the triazine-resistant species. Some activity on annual grasses but these will be the first to escape. Cultivation may be required. UPTAKE AND TRANSLOCATION: Primarily uptake is through the roots of germinating weed seedlings although leaf uptake is possible. Translocated upwards in the xylem to the shoots. BASIS OF SELECTIVITY: Monolinuron is placed on the soil surface and moves down into the zone of germinating weed seeds but not deep enough to come in contact with the roots of germinating crop plants. APPLICATION METHODS: Preemergence. For beans apply before the beans and weeds emerge; beans should be planted 4 to 5 cm deep; shallow planted crops may be injured; do not use on soils with less than 3% organic matter. On potatoes, apply preemergence or when plants are covered by hilling. RESIDUAL ACTIVITY: Relatively short, 4-6 weeks. UNIQUE CHARACTERISTICS: Moisture is required for distribution into the top layer of soil where weed seeds are germinating.

NALCO-TROL. TYPE OF ADJUVANT: Drift control agent. CHEMICAL COMPOSITION: Polyvinyl polymer. REGISTERED USES: For use with 2,4-D ester or amine, picloram, paraquat, simazine or dicamba for weed or brush control in non-crop land. BENEFIT: Reduces drift, improves canopy penetration and foliage coverage. MODE OF ACTION: Reduces spray breakup and thus the number of fine driftable droplets. MIXING: 3-1000 mL/1000 L, depending on pressure, height and nozzle type. Add water and while agitating, add Nalco-Trol before adding liquid herbicides. Add wettable powder herbicides to water and ensure dispersion before adding Nalco-Trol. UNIQUE CHARACTERISTICS: Product is extremely slippery; care should be taken when working on spray equipment and following a spill.

NAPTALAM. TRADE NAME: ALANAP. CHEMICAL FAMILY: Amide. CROP AND/OR NON-CROP REGISTRATIONS: Cucumbers, melons, squash and pumpkins. SENSITIVE WEEDS: Seedlings of bindweed, chickweed, cocklebur, lamb's-quarters, pigweed, purslane, ragweed, velvetleaf, crab grass and foxtail. UPTAKE AND TRANSLOCATION: Inhibits seed germination and may be absorbed through the root system after germination. APPLICATION METHODS: Preemergence. Soil clods should be thoroughly broken up and pulverized to give a smooth surface before spray application. Apply up to 48 hours after planting. Following application the soil should not be disturbed unless later weed growth makes cultivation necessary. A second application may be applied to cucumbers and melons about one month after the first spray, when the crop has emerged but before the weeds are up. Use lower rates on light soil, higher rates on heavy soil. RESIDUAL ACTIVITY: Completely decomposes in 6-8 weeks. UNIQUE CHARACTERISTICS: Do not apply during very wet, cold weather as stunting of the crop may result. Avoid spray drift to areas planted to sensitive crops such as beets, tomatoes and spinach.

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

NAPTALAM/DINOSEB. TRADE NAME: DYANAP. CHEMICAL FAMILY: Amide/phenol. CROP AND/OR NON-CROP REGISTRATIONS: Cucumbers. SENSITIVE WEEDS: Seedlings of pigweed, lamb's-quarters, ragweed, purslane, mustards, barnyard grass, crab grass and foxtail. Will not control perennial or established weeds. BASIS OF SELECTIVITY: Placement of seed below herbicide treated zone. APPLICATION METHODS: The area to be treated should be well prepared and free from stubble and litter; soil clods should be broken up. Thorough, uniform coverage of the surface is essential for good weed control. Apply as a preemergence spray before the crop emerges. If soil is cold at time of seeding, delay application until soil temperature warms up. Do not apply after crop has emerged. Use the lower rate on light soils, the higher rate on heavy soils. The naptalam/dinoseb mixture provides more consistent weed control in dry soil and better annual grass control than naptalam alone. RESIDUAL ACTIVITY: Completely decomposes in 6-8 weeks. UNIQUE CHARACTERISTICS: Avoid spray drift to areas planted to sensitive crops such as beets, tomatoes and spinach. A heavy rain greater than 1.25 cm after application could cause crop damage on coarse sandy loam and fine silt loam soils.

NORBAK. TYPE OF ADJUVANT: Drift control agent. CHEMICAL COMPOSITION: Polyacrylic polymer. REGISTERED USES: May be added to spray mixes containing picloram/2,4-D, 2,4-D amine, 2,4-D/2,4-DP low volatile esters or dicamba used for weed and/or brush control on non-crop land. BENEFIT: Thickens spray and thus reduces drift. MODE OF ACTION: Polymer particles swell in water and create larger particles which are less prone to drift. MIXING: Refer to label instructions. Mixing rates vary with herbicide, formulation (amine vs ester), water hardness and water temperature. UNIQUE CHARACTERISTICS: Requires specially designed equipment for complete and uniform dispersion. Lumping may occur if NORBAK is added too quickly, particularly with amine formulations, cold water or hard water.

OIL (See MINERAL OIL)

OXYFLUORFEN. TRADE NAME: GOAL. CHEMICAL FAMILY: Diphenyl ether. CROP AND/OR NON-CROP REGISTRATIONS: Onions. SENSITIVE WEEDS: Purslane, pigweed, nightshade, wild buckwheat, lamb's-quarters. UPTAKE AND TRANSLOCATION: Primarily foliar absorption but some root absorption. Very little movement within the plant following foliar or root absorption. APPLICATION METHODS: Postemergence. Best control is obtained when weeds are in the two to four leaf stage and actively growing. The first application can be made when onions have two fully developed true leaves. Repeat applications may be necessary to control late-germinating weeds. Use at least 500 litres of water per hectare. RESIDUAL ACTIVITY: Limited preemergence activity. UNIQUE CHARACTERISTICS: Use only on dry bulb onions. Do not use when crop or weeds are under stress. Do not apply within 56 days prior to harvest.

PARAQUAT. TRADE NAME: GRAMOXONE. CHEMICAL FAMILY: Bipyridylium. CROP AND/OR NON-CROP REGISTRATIONS: Apples, apricots, cherries, currants, gooseberries, grapes, high bush blueberries, peaches, pears and plums established more than one year; blackberries, loganberries and red raspberries; inter-row spraying in strawberries; stale seedbed technique for vegetables and fieldcrops; inter-row directed chemical weeding for vegetable, field and established nursery crops; asparagus; potatoes; established alfalfa and bird's-foot trefoil; pasture renovation; zero-tillage corn; conifer control; turf renovation; chemical mowing and weed control in non-crop land; aquatic weed control. SENSITIVE WEEDS: Non-selective — affects all green plants. UPTAKE AND TRANSLOCATION: Absorbed by foliage and green bark; little or no translocation. BASIS OF SELECTIVITY: All green plant tissue is sensitive. Less effective on plants with a very waxy cuticle and linear leaf shape such as nutsedge. Safe on mature (non-green) bark of woody plants. APPLICATION METHODS: Postemergence. Broadcast, or directed spray to avoid contacting leaves or bark of desirable plants. Apply when weeds are less than 15 cm high. Better results are usually obtained if application is made on a dull or cloudy day, or in the evening. RESIDUAL ACTIVITY: Essentially no residual activity in soil. Will persist in organic material such as mulches or turf thatch; therefore, do not reseed these areas for 5 days. More than one application per season may be necessary, especially for perennial weeds. UNIQUE CHARACTERISTICS: Inactivated by adsorption to soil particles. Not available to homeowners. For a domestic registration, see paraquat/diquat.

PARAQUAT/DIQUAT. TRADE NAME: WEED & GRASS KILLER. CHEMICAL FAMILY: Bipyridyl/bipyridyl. CROP AND/OR NON-CROP REGISTRATIONS: "Chemical mower" to control weeds on driveways, pathways and other non-cultivated areas. SENSITIVE WEEDS: All green plant tissue. Less effective on plants with a thick, waxy cuticle such as nutsedge. UPTAKE AND TRANSLOCATION: Foliar contact activity. Little or no translocation. BASIS OF SELECTIVITY: No selectivity for green plants. Will not penetrate the mature (non-green) bark of woody plants. APPLICATION METHODS: Postemergence. RESIDUAL ACTIVITY: Essentially none; inactivated by adsorption to soil particles. May remain active in turf thatch after application, therefore, thorough cultivation of a turf area is required before seeding. UNIQUE CHARACTERISTICS: Best results follow application on dull or cloudy days, or in the evening.

PARAQUAT/SIMAZINE. TRADE NAME: TERRAKLENE. CHEMICAL FAMILY: Bipyridylium/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Apples, pears, grapes, raspberries, highbush blueberries, asparagus, woody ornamentals and nursery stock, shelter-belts and non-crop land. SENSITIVE WEEDS: Annual grasses and broadleaf weeds. UPTAKE AND TRANSLOCATION: Foliar absorption by paraquat but no translocation; simazine is absorbed by roots, and translocated to leaves and shoots. BASIS OF SELECTIVITY: Used only on established plantings. APPLICATION METHODS: Foliar postemergence spray directed away from green bark and desirable foliage. For asparagus, apply after weed emergence but before crop emergence. The best foliage burn will result when applied on a dull or cloudy day, or in the evening. RESIDUAL ACTIVITY: Up to a year, depending on rate. UNIQUE CHARACTERISTICS: The mixture provides a rapid burn of existing green plant tissue and residual control of germinating weeds. Should be used only under established plants. Lower rates should be used on sandy soil.

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

PEBULATE. TRADE NAME: TILLAM. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Tobacco, tomatoes, red beets and sugarbeets. SENSITIVE WEEDS: Annual grasses (crab grass, barnyard grass, wild oats, foxtails), yellow nutsedge, horsetail and some annual broadleaf weeds. UPTAKE AND TRANSLOCATION: Absorbed by roots, hypocotyl and seed. Translocated upward to growing point. BASIS OF SELECTIVITY: Tolerant species degrade herbicide. Also, food reserves in seed allow seedling to outgrow chemical effect. APPLICATION METHODS: Preplant incorporated. May be applied using water or liquid fertilizer as the carrier. Dry fertilizers may also be used as the carrier when impregnated by a licensed fertilizer dealer. Incorporate uniformly into the soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. When application and incorporation are separate operations, application should be to a dry soil surface. RESIDUAL ACTIVITY: Provides season-long weed control without soil residues the following season. UNIQUE CHARACTERISTICS: Rainfall is not required for activation. Leaching is not significant, even with heavy rainfall.

PICLORAM. TRADE NAME: TORDON 10K. CHEMICAL FAMILY: Pyridine. CROP AND/OR NON-CROP REGISTRATIONS: Weed and brush (including conifers) control in non-crop locations, industrial sites and rights-of-way. SENSITIVE WEEDS: Most broadleaf weeds and most woody plants except white ash. UPTAKE AND TRANSLOCATION: Rapidly absorbed by roots, stems or foliage. Translocation can be up or down, but like 2,4-D, accumulation is in young rapidly growing meristematic tissues. BASIS OF SELECTIVITY: Effects on nucleic acid metabolism and growth are not observed in grasses and other tolerant species. APPLICATION METHODS: Granular applications to soil. RESIDUAL ACTIVITY: A half-life in soil of 18-24 months can be expected in northern Ontario situations. Disappearance can be more rapid under warm, humid conditions but a 30% residue carry over can be expected in southern Ontario agricultural areas. UNIQUE CHARACTERISTICS: A permit from the Ontario Ministry of the Environment is required for use of picloram in Ontario. Because of its high activity on most broadleaf plants and its persistence for three or more years in soil, picloram may not be applied on land used, or land that may be used, for the production of agricultural crops. It must not be applied over or near areas where roots of desirable trees or other plants may extend, or where the chemical may be washed or otherwise moved into contact with roots. The permit requirement provides a means for keeping record of treated areas so that damage to non-target vegetation can be prevented.

PICLORAM/2,4-D. TRADE NAME: TORDON 101. CHEMICAL FAMILY: Pyridine/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Non-crop land. SENSITIVE WEEDS: Most broadleaf herbaceous weeds including Canada thistle, sweet and red clover, wild carrot, common ragweed, dandelion, goldenrod, dock, plantain, prickly lettuce, burdock, fleabane and vetch; deciduous and coniferous woody plants. APPLICATION METHODS: Drenching spray to foliage, stem and root collar of woody plants up to 2.5 m tall after foliage is well developed in spring. Cut surface treatment of unwanted trees. Postemergence to broadleaf herbaceous weeds in spring or early summer after growth begins. UNIQUE CHARACTERISTICS: A permit from the Ontario Ministry of the Environment is required to use picloram/2,4-D in Ontario. See also notes for 2,4-D and picloram (especially precautions for picloram).

PROMETRYNE. TRADE NAME: GESAGARD. CHEMICAL FAMILY: S-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Potatoes, carrots, peas and transplanted celery. SENSITIVE WEEDS: Lamb's-quarters, lady's-thumb, corn spurry, pigweed, wild mustard, purslane, chickweed, hemp-nettle and green foxtail. UPTAKE AND TRANSLOCATION: Absorbed through foliage and roots. Translocated upwards through xylem accumulating in the apical meristems. BASIS OF SELECTIVITY: Metabolized by tolerant plants and to a lesser extent by sensitive plants, although this is not thought to be the major selective mechanism. APPLICATION METHODS: Preemergence or early postemergence (before weeds are 5 cm high). Apply before potatoes, carrots or peas emerge. Apply 7 to 14 days after celery is transplanted. RESIDUAL ACTIVITY: About 6 to 8 weeks. A fall cover crop of rye or oats may be sown on the treated land in the same season.

PROPANIL/MCPA. TRADE NAME: STAMPEDE CM. CHEMICAL FAMILY: Acetanilide/phenoxy. CROP AND/OR NON-CROP REGISTRATIONS: Spring wheat, barley and oats. SENSITIVE WEEDS: Green and yellow foxtail; certain broadleaf weeds such as wild buckwheat, lady's-thumb and pale smartweed. UPTAKE AND TRANSLOCATION: Propanil is absorbed by leaves; translocated to growing point of shoot and then back to other leaves. MCPA is absorbed by leaves; translocated to growing points of shoot and root. BASIS OF SELECTIVITY: Faster metabolism of herbicide by tolerant species. APPLICATION METHODS: Postemergence. Best control is obtained when weeds are small and actively growing, relative humidity is high and daily maximum temperature exceeds 21°C. Apply when cereals are in the 2 to 5 leaf stage and weeds are in the 1 to 4 leaf stage. Do not apply if daily maximum temperature is not expected to exceed 10°C or if frost is expected within 24 hours. Thorough spray coverage is necessary. RESIDUAL ACTIVITY: None. UNIQUE CHARACTERISTICS: May cause crop yellowing or tip burn but these effects are temporary and normally disappear in 10 to 14 days.

PROPYZAMIDE. TRADE NAME: KERB. CHEMICAL FAMILY: Amide. CROP AND/OR NON-CROP REGISTRATIONS: Alfalfa, bird's-foot trefoil, woody nursery stock, apples, pears, lowbush blueberries. SENSITIVE WEEDS: Perennial grasses including quack grass, annual grasses, volunteer cereals and common chickweed. UPTAKE AND TRANSLOCATION: Taken up by plant roots and translocated to the foliage. Little foliar absorption. BASIS OF SELECTIVITY: Faster degradation in tolerant species. APPLICATION METHODS: Preemergence to annual weeds. Postemergence control of perennial grasses when applied in the fall. Apply in the fall from late September to early November when the soil temperature is low but above freezing, and soil moisture is high.

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

RESIDUAL ACTIVITY: Persistence is variable (2 to 9 months), depending on soil type and climatic conditions. Decomposition of the herbicide is slow at temperatures below 15°C but accelerates at temperatures above this level. Persistence is greatest in sandy soils with low organic matter. UNIQUE CHARACTERISTICS: Rainfall or irrigation is required after application to move the herbicide into the root zone for uptake by perennial grasses and germinating annual grasses.

PYRAZON. TRADE NAME: PYRAMIN FL. CHEMICAL FAMILY: Pyridazinone. CROP AND/OR NON-CROP REGISTRATIONS: Sugar beets and table beets. SENSITIVE WEEDS: Black nightshade, chickweed, knotweed, lady's-thumb, lamb's-quarters, oak-leaved goosefoot, prostrate pigweed, purslane, ragweed, redroot pigweed, shepherd's-purse, smartweed, stinkweed, wild buckwheat, wild carrot (seedling), wild mustard, wormseed mustard and yellow rocket (seedling). UPTAKE AND TRANSLOCATION: Can be taken up by both roots and leaves, but translocation is upward to leaves where it inhibits photosynthesis. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Preplant incorporated, preemergence, or postemergence after the second-true-leaf stage of the beets. RESIDUAL ACTIVITY: Average persistence is about 4 to 8 weeks in soil depending on soil moisture and temperature. Residue carry over problems are unlikely. UNIQUE CHARACTERISTICS: With preemergence applications, at least 1.25 cm of rainfall is required for good weed control. Combinations of pyrazon and TCA are most useful where both annual broadleaf weeds and grasses are a problem. These treatments may not be effective on high organic soils or dry soils (i.e. muck soils or with late planted beets when soils are drier). Under these circumstances, postemergence applications of pyrazon plus TCA as a band over the row may be most effective. However to be selective and effective the chemicals must be applied after the cotyledons of the beets are 2.5 cm long and before the weeds have reached the 4-true-leaf stage (10 cm). Where TCA has been used, beet tops should not be fed to livestock. TCA residues in the soil can be a problem for some crops such as corn.

SETHOXYDIM. TRADE NAME: POAST. CHEMICAL FAMILY: Unique. CROP AND/OR NON-CROP REGISTRATIONS: Rapeseed (canola), flax, soybeans, dry beans, snap beans, peas, onions, tomatoes and potatoes. SENSITIVE WEEDS: Annual grasses (wild oats, foxtails, barnyard grass, large crab grass, proso millet, fall panicum and witch grass), volunteer corn and cereals, and quack grass. UPTAKE AND TRANSLOCATION: Absorbed by foliage. Translocated upwards and downwards in plant. BASIS OF SELECTIVITY: Degraded by tolerant species (broad leaf plants). APPLICATION METHODS: Postemergence to actively growing annual grasses in the 1 to 6 leaf stage and quack grass in the 1 to 3 leaf stage. Use flat fan nozzles and add ASSIST OIL CONCENTRATE to the spray mix. Lower rates may be used for quack grass control when ammonium sulphate is added to the spray mix. Aerial application is also registered. RESIDUAL ACTIVITY: Essentially none. A second application and/or cultivation may be necessary to control grasses which emerge after treatment. UNIQUE CHARACTERISTICS: Susceptible grasses, when sprayed, stop growing immediately and then gradually turn yellow to purple to brown over a period of 7 to 21 days depending on growing conditions and crop competition. Rainfall within one hour after application may reduce effectiveness. If treated grasses are stressed (drought, flooding, prolonged cool temperatures) control will be delayed or reduced.

SIDURON. TRADE NAME: FERTILIN TURF FERTILIZER WITH CRAB GRASS PREVENTER. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Lawns and turf. For use in established plantings of blue grass, fescue, redtop, smooth brome, perennial rye grass, orchard grass, and certain strains of bent grass (PenCross, Seaside, Highland, Astoria, Nimisila, C-1, C-7, and C-19). SENSITIVE WEEDS: Germinating annual grasses such as crab grass, barnyard grass and foxtail. UPTAKE AND TRANSLOCATION: Readily absorbed through roots, less so through foliage. Translocates in xylem. BASIS OF SELECTIVITY: Root growth inhibition in germinating sensitive species. Sensitive species affected only in seedling stage. APPLICATION METHODS: Preemergence. In spring just before expected emergence of annual weedy grasses. The only formulations available are ones combined with a fertilizer. RESIDUAL ACTIVITY: No evidence of residues in soil after one year. UNIQUE CHARACTERISTICS: Will cause damage to some bent grass strains.

SIMAZINE. TRADE NAMES: PRINCEP NINE-T, SIMADEX SIMAZINE FLOWABLE. CHEMICAL FAMILY: S-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Corn; established asparagus, bird's-foot trefoil, raspberries, loganberries, blackberries, highbush blueberries; alfalfa, apples and pears established for one year or more; grapes established for three or more years; shelter belts established for at least one growing season (caragana, green ash, Siberian elm, American elm and Manitoba maple); new or established Christmas tree and woodland plantations (two year or older white pine and balsam fir); woody ornamentals and nursery stock established for at least one year (cedar, barberry, apple, flowering crabapple, boxwood, cotoneaster, dogwood, holly, rose, yews, chamaecyparis, hemlock, juniper, multiflora rose, peony, spruces, mugho pine, black walnut and white ash); aquatic weed control; non-crop land. SENSITIVE WEEDS: Annual broadleaf weeds such as pigweed, lady's-thumb, lamb's-quarters, purslane, ragweed, volunteer clover, wild buckwheat, smartweed, plantain and groundsel; annual grasses such as barnyard grass, crab grass, wild oats and yellow foxtail (triazine-resistant biotypes of foxtail, lamb's-quarters, pigweed and groundsel will not be controlled); most perennial species starting freshly from seed; pond scums and filamentous algae such as *Chara* and *Nitella*, most emerged and submerged aquatic vegetation. UPTAKE AND TRANSLOCATION: Absorbed by roots; little or no foliar absorption; translocated upwards in xylem, accumulating in apical meristem and leaves. BASIS OF SELECTIVITY: Some species, such as corn, metabolize simazine. In most crops, selectivity is based on the roots of the crop plants being deeper than the depth to which simazine leaches. APPLICATION METHODS: Preplant incorporated (to a depth of 2.5 cm)

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

or preemergence in corn; preemergence in other crops. Broadcast or band application. In fruit crops, apply a one metre wide band under the plants; cultivate or sod the area between the rows. For aquatic weed control, apply as a drawdown treatment or water volume application in drainage ditches and ponds with no water flow-through. RESIDUAL ACTIVITY: Soil residues may persist for more than one season. After spraying with simazine, do not plant any crop in the treated area in the same year except corn. Where rates in excess of 2 kg/ha have been applied, do not plant rotational crops in the following year; soil should be tested if there is any question of excessive residues remaining. UNIQUE CHARACTERISTICS: Needs sufficient moisture to be activated. Should be applied only once per season. To avoid build-up of resistant weeds, simazine should be rotated with other non-triazine residual herbicides. Simazine is more persistent than atrazine. Where rainfall is sufficient to cause erosion, soil containing simazine may wash to lower areas of land and injure existing or subsequent crops.

SPRAY ADJUVANT DEFOAMER. TYPE OF ADJUVANT: Defoamer. CHEMICAL COMPOSITION: Dimethylpolysiloxane. REGISTERED USE: To reduce foaming in spray mixes of atrazine. BENEFIT: Reduces foaming. MIXING: To control foam when mixing spray solution, add defoamer either just before or during addition of any other spray adjuvant. To cut existing foam, add defoamer to tank and recirculate solution until foam dissipates. UNIQUE CHARACTERISTICS: Do not use with any other herbicide or herbicide/adjuvant mixture.

SURFACTANTS (see AGRAL 90, CITOWETT PLUS, FRIGATE)

TBA. TRADE NAME: TBA-4 GENERAL WEED KILLER. CHEMICAL FAMILY: Benzoic acid. REGISTERED USES: Control of deep rooted perennial weeds and brush in non-crop land. SENSITIVE WEEDS: Leafy spurge, field bindweed, Canada thistle and evergreens. UPTAKE AND TRANSLOCATION: TBA is translocated either upward or downward in plants but accumulation is in the rapidly growing meristematic areas. BASIS OF SELECTIVITY: Depends on rates, absorption, translocation, and retention at sites of action. TBA is not highly selective but grasses are normally the first to recover in treated areas. APPLICATION METHODS: As a coarse spray applied with low or moderate pressure to both weed foliage and soil. Best results are obtained just after foliage first appears in the spring. UNIQUE CHARACTERISTICS: TBA is quite persistent and highly mobile in soil. These properties contribute to its effectiveness in controlling deep rooted perennial weeds. However soil residues can remain injurious to sorghum, wheat or soybeans for 2 or more years depending on the application rate. It should not be applied near valuable trees or shrubs, and care should be taken to avoid spray drift onto desirable broadleaf plants.

TCA. TRADE NAME: NATA, SODIUM TCA. CHEMICAL FAMILY: Trichloroacetic acid. CROP AND/OR NON-CROP REGISTRATIONS: Barley, oats, red beets, non-crop land. SENSITIVE WEEDS: Annual grasses, quack grass and conifers. UPTAKE AND TRANSLOCATION: Absorbed more rapidly by roots than by foliage. Translocates readily and accumulates in growing tissues. BASIS OF SELECTIVITY: Differential growth inhibition. APPLICATION METHODS: In oats and barley, postemergence to grasses and crop; in beets, preemergence to crop; on non-crop land, pre or postemergence to grasses; for conifer control, foliar application. RESIDUAL ACTIVITY: About 3 to 10 weeks depending on rate applied, soil moisture and temperature conditions.

TEBUTHIURON. TRADE NAMES: SPIKE 80W, HERBEC 20P. CHEMICAL FAMILY: Substituted urea. CROP AND/OR NON-CROP REGISTRATIONS: Total vegetation control, or selective control of undesirable cut or standing brush in non-crop land or non-landscaped areas. SENSITIVE WEEDS: Only a few plant species, such as horsetail, are not controlled with tebuthiuron but rate requirements vary depending on the weed or brush species. UPTAKE AND TRANSLOCATION: Readily absorbed by the roots, translocated upward to leaves where it most likely acts as a photosynthetic inhibitor. SELECTIVITY: Few if any plants show physiological tolerance. APPLICATION METHODS: For total vegetation control, apply prior to, or during, the period of active plant growth. Control is enhanced by rainfall. For selective control of trees or stumps, apply tebuthiuron to the soil at the base of the stems. UNIQUE CHARACTERISTICS: Do not apply tebuthiuron on, or near, desirable trees or other vegetation, or on areas where roots of desirable plants may penetrate, or in locations where the chemical may be washed into contact with desirable plants. To avoid lateral movement, do not apply to frozen or snow covered soil, or when heavy rainfall is expected soon after application.

TERBACIL. TRADE NAME: SINBAR. CHEMICAL FAMILY: Uracil. CROP AND/OR NON-CROP REGISTRATIONS: Strawberries, highbush blueberries, apples, peaches and alfalfa. SENSITIVE WEEDS: Barnyard grass, bluegrass, crab grass, foxtail, chickweed, cheat grass, perennial rye grass, wild barley, mustard, prickly lettuce, stinkweed, annual sow-thistle, henbit, lamb's-quarters, pigweed, purslane and ragweed. Partial control of quack grass, horsenettle, vetch and yellow nutsedge. UPTAKE AND TRANSLOCATION: Uptake is mostly through roots, although partially through foliage and stem. Translocation is upward into leaves. BASIS OF SELECTIVITY: Used only on established plantings so roots of crop are below depth to which chemical penetrates. May also be slower translocation and faster degradation in tolerant species. APPLICATION METHODS: Apply to the soil surface in 200-1000 L water per hectare. Alfalfa must be dormant. If weed growth is present in apples, paraquat may be mixed with spray. Rates for strawberries are considerably lower and can be applied in spring, post-harvest or late fall. Control of perennial grasses may be improved by cultivation prior to treatment. RESIDUAL ACTIVITY: May be up to two years. Residues are likely to be higher on heavier soil types and if higher rates and repeated applications are used. UNIQUE CHARACTERISTICS: Moisture is necessary to activate the chemical within two weeks after application. Do not apply on soils with less than 1% organic matter, nor on eroded soil areas. Use lower rates on soils with 1 to 2% organic matter. Do not apply on weak or diseased strawberry plants.

TERBUTHYLAZINE/TERBUTRYN. TRADE NAME: TOPOGARD. CHEMICAL FAMILY: S-triazine/s-triazine. CROP AND/OR NON-CROP REGISTRATIONS: Potatoes. SENSITIVE WEEDS: Common chick-

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

weed, lady's-thumb, lamb's-quarters, mustard, pigweed, shepherd's-purse, smartweed and wild buckwheat. Under favourable soil and weather conditions, it may control barnyard grass, crab grass, green and yellow foxtail and witch grass. UPTAKE AND TRANSLOCATION: Absorbed through the roots and shoots of emerging weeds. BASIS OF SELECTIVITY: Metabolism by tolerant species. APPLICATION METHODS: Applied from preemergence to both crop and weeds, through to 10% emergence of the crop, provided the weeds are less than 5 cm in height. RESIDUAL ACTIVITY: In case of potato crop failure, do not follow in the same year with beets, radish, cucurbits or cole crops. UNIQUE CHARACTERISTICS: Adequate soil moisture is necessary for good weed control. Dry weather conditions will result in reduced preemergence weed control. If seedlings escape, a shallow cultivation will be necessary to remove them. Excessive rainfall after application may also result in reduced weed control.

TRIALLATE. TRADE NAME: AVADEX BW. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Spring wheat and barley, flax, rapeseed, sugarbeets, mustard and dry peas. SENSITIVE WEEDS: Wild oats. UPTAKE AND TRANSLOCATION: Absorbed mainly by the coleoptile of wild oats. BASIS OF SELECTIVITY: Not established. APPLICATION METHODS: Postplant incorporated (spring wheat and barley). Preplant incorporated (barley, flax, rapeseed, sugarbeets, mustard and dry peas). For postplant treatment of the cereals, the spray is applied to the soil after the crop is seeded and then thoroughly worked into the soil by harrowing twice, the second harrowing at right angles to the first; the crop should be seeded uniformly, deep enough so it is not disturbed by the harrow. For preplanting treatments, the chemical is sprayed on the soil surface and worked into the top 5 to 8 cm of soil with a disk or cultivator implement. The crop can be seeded anytime after treatment. In all treatments, the chemical should be worked into the soil within two hours after spraying. RESIDUAL ACTIVITY: Half-life in soil of approximately 6-8 weeks.

TRIFLURALIN. TRADE NAMES: RIVAL, TREFLAN. CHEMICAL FAMILY: Dinitroanaline. CROP AND/OR NON-CROP REGISTRATIONS: Soybeans, dry beans (white or kidney), faba beans, snapbeans, lima beans, black beans, rapeseed, triazine-tolerant rapeseed (variety O.A.C. Triton, pedigreed seed only), turnips, peas (field and canning), direct seeded alfalfa; transplants of tomatoes, peppers, brussels sprouts, broccoli, cabbage and cauliflower; carrots, crambe, direct seeded cabbage and cauliflower, annual flowers, woody nursery stock, perennials, established shelterbelts. SENSITIVE WEEDS: Effective on most annual grasses, and will provide good control of pigweed and lamb's-quarters, including the triazine-resistant strains of these weeds. UPTAKE AND TRANSLOCATION: No significant absorption or translocation of trifluralin in crops grown in soil treated with trifluralin. Susceptible weeds are controlled as they germinate. Established weeds are not controlled. BASIS OF SELECTIVITY: Physiological growth processes associated with seed germination. APPLICATION METHODS: Preplant incorporated. Apply in 100-300 L of water per hectare. Use lower rates of the chemical on sandy soils and increasing rate for loam to clay soils. Do not use on highly organic soils (muck, peat or black sands above 15% organic matter). Incorporate twice in cross directions using a tandem disc (7-10 km/hr) or tine cultivator (10-13 km/hr) set to work 8 to 10 cm deep. The first incorporation should be done as soon as possible after application, but may be delayed up to 24 hours. The second incorporation is recommended anytime before planting. Activated upon incorporation; rainfall is not required. RESIDUAL ACTIVITY: Recommended application rates provide season long weed control. Succeeding crops, even fall seeded grain crops planted in soil that received trifluralin the preceding spring, will not be injured under normal conditions. UNIQUE CHARACTERISTICS: Strongly adsorbed to soil particles and shows negligible leaching. Organic matter and clay content influence application rate. Does not control ragweed, annual nightshades or mustards; lady's-thumb may escape.

VERNOLATE. TRADE NAME: VERNAM. CHEMICAL FAMILY: Thiocarbamate. CROP AND/OR NON-CROP REGISTRATIONS: Soybeans and peanuts. SENSITIVE WEEDS: Annual grasses such as crab grass, barnyard grass and foxtails; yellow nutsedge. UPTAKE AND TRANSLOCATION: Uptake by roots, hypocotyls and germinating seeds. Translocation upwards to growing tip. BASIS OF SELECTIVITY: Tolerant species break down vernolate more rapidly. Also, food reserves in seed allow seedling to outgrow herbicide effect. APPLICATION METHODS: Preplant incorporated. Apply using water or liquid fertilizer as carrier. Incorporate uniformly into soil by setting the incorporation equipment (i.e., tandem disks, field cultivator with sweep teeth or vibrating shank S-tine cultivator) to work the soil approximately 10 cm deep followed by a levelling device. Irrigation (approximately 0.6 cm) can also be used to incorporate. If application and incorporation are separate operations, apply chemical to dry soil surface and incorporate within 4 hours. RESIDUAL ACTIVITY: Provides season-long weed control with no soil residues the following year to prevent crop rotation. UNIQUE CHARACTERISTICS: Does not need rainfall to be activated and will not leach significantly under heavy rainfall. Under unfavorable growing conditions, leaf crinkling may be observed but this usually does not affect yield.

Handy Metrics Conversion Factor

Litres per hectare x 0.4 = litres per acre
Kilograms per hectare x 0.4 = kilograms per acre

EQUIPMENT

INTRODUCTION — Herbicide application can and should be, a precision operation. Recent advances in equipment and control systems can make the job relatively simple and precise.

Pesticides applied incorrectly may result in wasted pesticide, poor or no control, damage to crops (possibly the neighbour's) or environmental contamination. Every effort must be made to apply chemicals properly to help eliminate these undesirable effects.

SPRAYERS FOR HOME USE — A 9 to 14 L knapsack or compressed air garden sprayer is satisfactory for use on lawns and around the home. A nozzle tip which produces a fairly coarse spray will help reduce spray drift. Care should be taken to keep the pressure relatively low since pressures of up to 700 kPa can easily be obtained. High pressures produce more very small spray droplets which can drift in light winds to susceptible garden plants. The sprayer should be reserved for use with herbicides and should **NOT** be used to apply insecticides or fungicides.

FIELD SPRAYERS — The most common sprayer used in herbicide application is the broadcast-boom sprayer. This sprayer applies an even swath of herbicide across the width of the boom.

The main requirements for field spraying are: (1) a uniform pressure, (2) a uniform forward speed, (3) a stable boom height to assure uniform overlap of the nozzle tip patterns and (4) an application rate between 55 and 450 litres per hectare.

Most commercially built sprayers can be adapted and used safely to apply liquid fertilizers. Extra agitation may be required. It is up to the individual to assure that the sprayer components being used are compatible with the fertilizer formulation and follow the manufacturer's recommendations.

AIR-BLAST or MIST SPRAYERS — The machines should **never** be used to apply herbicides, especially hormone-type herbicides such as 2,4-D. The danger of causing herbicidal damage at a great distance from the treated area is very great.

AERIAL APPLICATION of herbicides may be used where large acreages of a crop are grown in a solid block and non-susceptible crops are nearby. Application of hormone-type herbicides (see glossary) by aircraft is **NOT** recommended in areas of intensive agriculture where susceptible crops may be damaged.

Aerial applicators must be licenced by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of the Pesticides Act for the application of Schedules 1 and 5 herbicides and Schedule 2 hormone-type herbicides. Inspection will be conducted by Ministry Personnel to ensure safety of application.

It is an offense under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary measures must be taken at all times to prevent drift. (See Section on Drift of Herbicides.)

CARE AND USE OF EQUIPMENT

SPRAYING SPEEDS — Since the application rate for most agricultural and roadside herbicide applications must be uniform, it is imperative that the forward speed of a sprayer be **constant** whenever liquid is being delivered by the nozzles. If the driving wheels of a tractor slip on the soil surface, the tractor's speedometer does not indicate a change in forward speed. To be certain that the forward speed is constant in spite of wheel slippage on hills, use an independent speedometer equipped with a ground-driven wheel. Spray Monitors may also be installed. These automatically correct for variation in tractor speed to maintain a constant rate of application.

WATER — Use only clean water that has all debris, sand and mud removed from it. Never allow the intake screen to rest on the bottom of a farm pond while filling a sprayer. The intake line, near the screen, should be equipped with a check valve or back flow device to prevent contamination of the pond or stream when the pump is shut off. The use of a tank-refilling nozzle, volume booster nozzle or injection pump to aid in refilling the sprayer tank from farm ponds or streams should be avoided. These tank-refilling aids may cause pond or stream contamination.

AGITATION — When chemical solution formulations are used (2,4-D and water) at least 2 to 14 L per minute should be returned to the tank for agitation within the tank. The return or bypass line from the pressure regulator should deliver the liquid to the bottom (**not** the top) of the tank to be effective.

When wettable powders (atrazine, etc) are used, the return to the tank should be 14 to 27 L per minute for each 450 L of tank capacity, depending on the concentration of the wettable powder and the size of the tank. A special line from the pressure side of the pump (**not** the pressure regulator) to the tank must be used to carry the 14 to 27 L per minute necessary for hydraulic agitation in the tank using a Venturi Jet or sparge tube. This flow can be reduced if the sprayer has a mechanical agitator. (The sparge tube agitators require much more water to give the same agitation flow.)

To prepare a tank-mix of a wettable powder and an oil or emulsifiable concentrate, proceed as follows unless specific instructions are given on the product label:

1. Fill the sprayer tank with water to the half-full mark.
2. Start the agitator and pour in a premixed slurry of wettable powder and water.
3. Agitate for 2 to 3 minutes before adding more water.
4. Add the oil or emulsifiable concentrate last.

Avoid excessive agitation of the mixture, it may turn into a grease-like mass which will settle to the bottom of the tank. The mixture may foam excessively.

To prevent a buildup of oil in the sprayer, the tank should be emptied completely before refilling. After any break in the spraying operation agitate thoroughly before proceeding. Clean the tank and sprayer immediately after use with a detergent or solvent and flush with clean water.

PUMPS — The heart of the sprayer is the pump. It should have adequate capacity to maintain the desired pressure and volume. Piston, diaphragm and centrifugal pumps are better suited for pumping wettable powder suspensions. Roller pumps are ideal for the handling of most solution or emulsion herbicide formulations. When used for wettable powders or flowable formulations use a pump with an abrasion resistant housing. Read the manufacturer's care and storage instructions to gain optimum pump performance.

> **CAUTION:** Never allow a sprayer pump to run without water, even for a short time.

NOZZLE TIPS — Care should be taken to maintain a stable boom height to assure uniform overlap of the tip patterns. At approximately 46 to 51 cm between tip and target height there should be sufficient overlap to prevent missed weeds in the target height area.

The quality of the spray job is totally dependent on the quality of the nozzle tips. Machined orifice tips of stainless or hardened stainless steel produce consistent pattern quality over the life of the tip. Moulded orifice tips have a tendency to produce heavy centres and irregular deposits when overlapped.

Brass flat pattern nozzle tips are commonly used for spraying chemicals in solution. However, wettable powders are abrasive and can enlarge the nozzle opening. The Table below is a guide based on studies of the rate of wear of nozzle types.

Sprayers should be calibrated frequently. (See sprayer calibration following)

Nozzle tips are expendable items and should be replaced when they deliver 10% more than they did when new. Worn nozzle tips provide uneven distribution of solution and changes in spray pattern. They can also produce streaks across the field by delivery of too much herbicide to a given area.

Relative Durability of Materials Used in Flat-pattern 13 Nozzle Booms

Material	Durability compared with brass	Maximum area before replacing nozzles
Brass	1	12 hectares
Plastic	3	35
Stainless Steel	19	600
Hardened Stainless Steel	77	more than 600
Ceramic	above 77	

Flat-pattern Nozzle tips are the best for boom-type sprayers used for applying herbicides. Spraying pressure should be maintained at 275 kPa for standard flat fan elliptical orifice tips.

By using 110° instead of 80° series Flat-pattern nozzle tips and maintaining the same 51 cm spacing and same height as the 80° tips the patterns will be in full overlap. This reduces misses should the boom bounce as the sprayer travels over rough ground. Other tips can be useful for special application.

Flooding fan nozzle tips are used at low pressures and, because of their wide spray angle, can be used closer to the ground surface, thus reducing the drift hazard. The distribution of herbicidal materials may not be as uniform with flooding fan nozzle tips as with the flat-pattern tips. Flooding fan nozzle tips are available in brass, plastic and stainless steel. Half as many of these nozzle tips are required to cover the same width as would be required with flat-pattern nozzle tips. Sprayers equipped with a **broadcast type** of nozzle or nozzles cover a wide swath. They are especially convenient for farm lane and fencerow spraying where a uniform spray pattern is not essential. The spray pattern is affected by wind and severe drifting may occur with even a light breeze. Never use a broadcast type of nozzle to spray near a susceptible crop.

Full or hollow cone nozzle tips may be used for applying herbicides to the soil surface when the herbicide is incorporated or mixed into the soil with a disk harrow, cultivator or similar tillage implement. Special **even-spray nozzle tips** are available for band applications of herbicides. The width of the sprayed band is controlled by the height and spray angle of the nozzle tips as well as its orientation to the direction of travel. Manufacturer's literature and directions should be followed explicitly.

> **NOTE** When using any nozzle for spraying wettable powders, it is essential to calibrate the sprayer frequently because as a nozzle wears, the quantity of spray material delivered **increases** and distribution is not even.

CLEANING THE SPRAYER — Pump at least 225 L of clean water through the sprayer at the end of the day or when changing from one herbicide to another. Clean the nozzle tips and all screens at the same time. This will help reduce the gummy deposits or the wettable powder accumulations in the sprayer. Wash the sprayer immediately after each use.

Equipment that has applied 2,4-D, MCPA, or related herbicides should **not** be used to spray fungicides or other materials on susceptible crops, and should **not** be parked or stored near greenhouses or other areas where susceptible crops are grown. If the sprayer has a good tank and connecting hoses, and has been used to apply only the amine or sodium salt formulations of 2,4-D, etc (not the ester), it may be used fairly safely on susceptible crops following a thorough cleaning of tank, hoses, boom, nozzles, etc, with a strong (preferably hot) solution of a detergent or alkaline cleaner, followed by a thorough rinsing with clean water. See Agriculture Canada Publication 1482, Field Sprayers.

The wash water contains herbicide. Never allow the wash water to run into a farm pond, stream, or other source of clean water.

SPRAYER CALIBRATION (Determining application rates in litres per hectare)

There are many ways of determining the number of litres of spray material that is being applied to one hectare of land — or calibrating a sprayer. Here is a method that is straightforward and the resulting calculation is relatively simple:

1. Set out two stakes 200 metres apart in the field. Do not use a different distance: to do so will give the wrong value to use in the calculation.

2. Pick a level spot and fill the sprayer tank with clean water.

Adjust the boom-height to give the amount of overlap recommended by the sprayer manufacturer for the nozzle tips and nozzle spacing used. For example, for a spray angle of 65 degrees the boom should be 53 to 58 cm above the surface to be sprayed, for 80 degrees the height should be 42 to 48 cm. Operate the sprayer and adjust the bypass pressure-relief valve to give the desired pressure while the nozzles are operating. This will also ensure that the supply line up to the shutoff valve is full. Fill the tank and **record the water level on a measuring stick**.

3. Spray between the stakes in one direction at a **definite speed and pressure**. Turn the boom on as the first stake is passed and turn the boom off as the second stake is passed. **Mark the throttle setting.**

4. Return the sprayer to the same location as before the calibration run. Carefully measure the amount of water required to refill the tank to the same mark on the measuring stick.

5. Calculate application rate in litres per hectare using this formula:

$$\text{L/ha} = \frac{\text{litres of water added} \times 50^*}{\text{boom lengths in metres}}$$

*The factor is obtained by dividing the number of square metres in a hectare by the distance travelled.

$$\frac{10{,}000}{200} = 50$$

Sample calculations:

Overall Spraying: If the sprayer has a 9 m boom and 61 L of water are required to refill the tank, the application rate is:

$$\text{L/ha} = \frac{61 \times 50}{9} = 338.9 \text{ L}$$

Band Spraying: If the sprayer has 10 nozzles and each nozzle covers a 36 cm band, the total width of the spray patterns (boom length) is:

$$10 \times 36 = 360 \text{ cm}$$

or 3.6 m

If 10 litres of water are required to refill the tank, the application rate is:

$$\text{L/ha} = \frac{10 \times 50}{3.6} = 139 \text{ litres/hectare}$$

Sprayer calibration bottles are available to recheck the sprayer calibration. For further information contact your local office of the Ontario Ministry of Agriculture and Food.

When band spraying, the acreage actually sprayed is NOT the same as the crop acreage. The herbicide rates given in this publication are based on the area actually sprayed.

DETERMINING THE AMOUNT OF HERBICIDES NEEDED

Most rates suggested in this publication are given in terms of both active ingredient (common name) per hectare and product (TRADE NAME) per hectare. However, where the amount of active ingredient in the formulations available varies considerably (for example, 2,4-D is available in concentrations of 100 g/L, 400 g/L, 500 g/L, etc) the rate is given in terms of active ingredient only. To convert any rate given in terms of active ingredient per hectare to a rate in terms of product per hectare **consult Table 1** for the factor to use and the example of how to make the calculation. If the rate suggested is given in terms of product per hectare, simply use that amount. (Double check the label on the container before use for the amount of active ingredient contained.)

If 2,4-D like herbicides are involved, check Table 8 to see if the recommended rates will control a particular weed. Specific measures are required to handle weeds that do not respond to the routine program. These are outlined under the crop in question, in special sections, or in Table 6.

***Throughout the Recommendations sections of this publication**, the common name of each herbicide (its active material) is printed in lowercase letters (examples: atrazine, dicamba, glyphosate), whereas the product name (the total liquid, or powder, etc. inside the container as supplied by the manufacturer) is printed in capital letters (examples: AATREX, BANVEL, ROUNDUP), and its formulation is listed within brackets following the trade name.

After determining how much commercial product is needed per hectare, and calibrating the sprayer, divide the total number of litres held by the sprayer tank by the sprayer output per hectare to determine the number of hectares each tank will cover. This determines the quantity of herbicide needed, for that number of hectares, to add to the spray tank. Follow manufacturer's recommendations on mixing order and procedures.

MATERIALS, MIXING AND MIXTURES

Dry herbicide formulations include granules, soluble powders and wettable powders. **Granules** do not require any mixing, and are ready to apply as is. Many herbicides used for preemergence treatments are available as granular formulations. In nearly every case, the performance of the granular formulations is equivalent to that of the liquid. Satisfactory distribution may be obtained with the equipment available. **Soluble powders** can be dissolved in water. **Wettable powders** will not dissolve but will form a suspension which requires constant agitation.

Liquid herbicide formulations either mix in water to form a solution or may be oil-based and form an emulsion which will require agitation. Emulsions have a milky appearance. *When using more than one herbicide in a single application, it is safer to first mix one with the quantity of water to be used before the second is added. This procedure reduces the possibility of the formation of gums or precipitates which may clog nozzles and filters. It must be emphasized to consult the package labels for information on the compatibility of different herbicide products since certain formulations may react when mixed together, resulting in materials with different properties and activities than the original ones. Where water is known to have an excessive salt content, compatibility of the water and the chemical at field strength should be tested first on a small scale — see also section on Agitation in a sprayer.

Mixtures of different herbicides or mixtures of herbicides with other pesticides or foliar fetilizers should NOT be applied in a single application unless registered for use in this way.

UNLESS specifically mentioned in this publication, or on a herbicide label, the addition of a surfactant or a detergent to a spray solution by the applicator is NOT recommended.

NOTE: Trade names and common names of chemicals are cross-referenced in Table 1.

Keep Herbicides
in Original Containers
and
READ THE LABEL

Handy Metrics Conversion Factor

Litres per hectare x 0.4 = litres per acre
Kilograms per hectare x 0.4 = kilograms per acre

SPRING WHEAT, OATS and BARLEY NOT UNDERSEEDED to FORAGE CROPS

Weeds must be emerged from the soil surface and in early stages of growth to be killed by the rates of most of the herbicides used on cereal grains. Weeds which are growing during early periods of cereal growth (up to 5-leaf stage) have the greatest effect on the cereal yield.

Although cereals are quite resistant to chemicals like 2,4-D, they are most resistant in the 5- to 6-leaf stage of their growth. When counting the leaves on cereal plants, some confusion can occur if tiller leaves are present. These leaves are not counted. The above diagram may be useful when determining the cereal leaf stages referred to in the publication.

Crop rotation is a valuable technique used to prevent the buildup of weed populations associated with small grain production. Wild oats can increase in population and severely limit production on fields where small grains are grown continuously. Some weeds i.e., proso millet will be well controlled by cereal competition.

Cereal grains have an advantage in that they do not make use of the full growing season. This is particularly true of the winter cereals where pre-planting cultivation and postharvest cultivation can be used to stimulate germination of weed seeds and reduce perennial weed populations.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information see "Notes on Chemical" section.)
Broadleaf weeds such as mustards, lamb's-quarters, ragweed, pigweed	2,4-D* 2,4-D (500 g/L)	0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	Apply when the crop is in the 3- to 5-leaf stage of growth. Do not use on Mingo barley. On oats, do not apply more than 0.50 kg/ha (active) or 1 L/ha (500 g/L) product.
Broadleaf weeds such as hempnettle, mustards, lamb's-quarters, ragweed, pigweed	MCPA* MCPA (500 g/L)	0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	Apply when the crop is in the 2- to 5-leaf stage of growth. For hempnettle control, use the high rate of MCPA. The potassium salt formulation of MCPA is most effective on hempnettle.
Many broadleaf weeds including mustards, lady's-thumb, field bindweed, Canada thistle, and perennial sow-thistle	dicamba/2,4-D/mecoprop KIL-MOR (485 g/L)	0.41-0.53 kg/ha 0.85-1.1 L/ha	For barley, use only the lower rate and apply when the crop is in the 2- to 3-leaf stage. For wheat and oats apply when the crop is in the 3- to 4-leaf stage. The higher rate is required for control of Canada thistle and field bindweed.
	dicamba/MCPA/mecoprop TARGET (400 g/L)	0.40-0.60 kg/ha 1.0-1.5 L/ha	Use when wheat or oats are in the 2-5 leaf stage or barley is in the 2-3 leaf stage. Apply when weeds are in the 2-3 leaf stage. Use the high rate if weeds are beyond the 3 leaf stage.
Many broadleaf weeds including wild buckwheat, corn spurry, green smartweed, lady's-thumb, field bindweed, Canada thistle, and perennial sow-thistle	2,4-D* or MCPA* + dicamba 2,4-D or MCPA (500 g/L) + BANVEL (400 g/L) BANVEL (480 g/L)	0.28-0.42 kg/ha + 0.11-0.14 kg/ha 0.56-0.84 L/ha + 0.28-0.35 L/ha 0.23-0.29 L/ha	The 2,4-D or MCPA should be included if mustards are present. Use only the lower rate on barley. Apply to wheat, barley and oats when they are in the 2- to 5-leaf stage. Do not use dicamba + 2,4-D on oats.
	dicamba/MCPA K (1:4) DYVEL (420 g/L)	0.5 kg/ha 1.25 L/ha	Apply when cereals are in the 2- to 5-leaf stage. Hempnettle, corn spurry and cow cockle are controlled best when application is made early in this stage.
Many broadleaf weeds including wild buckwheat	dichlorprop/2,4-D (1:1) ESTAPROP (600 g/L)	1.1 kg/ha 1.75 L/ha	For spring wheat and barley only. Apply to emerged weeds when the cereals are in the 3- to 4-leaf stage.
Chickweed, corn spurry	mecoprop MECOTURF (150 g/L)	0.82 kg/ha 5.5 L/ha	Apply to emerged seedling weeds in spring wheat, oats and barley. Apply when the cereal is in the 3 leaf to flag leaf stage.
Lady's-thumb, wild buckwheat and many other broadleaf weeds	bromoxynil PARDNER (280 g/L) TORCH DS (450 g/L)	0.28 to 0.34 kg/ha 1.0 to 1.2 L/ha 0.625 to 0.75 L/ha	Use the lower rate if weeds are not past the 4-leaf stage. Thorough spray coverage of weed foliage is required for control. Application should be made before the cereals have more than 5 leaves because spray coverage will probably not be adequate beyond this stage.

Lady's-thumb, wild buckwheat and many other broadleaf weeds	bromoxynil/MCPA (1:1) BUCTRIL M (560 g/L) SABRE (720 g/L)	0.56 kg/ha 1.0 L/ha 0.78 L/ha	Apply before the weeds have more than 5 leaves and the cereals are in the 2- to 5-leaf stage because spray coverage will probably not be adequate beyond this stage.
Lady's-thumb, wild buckwheat, mustards, hempnettle, and many other broadleaf weeds	bromoxynil + 2,4-D* or MCPA* PARDNER (280 g/L) + 2,4-D (500 g/L) or MCPA (500 g/L)	0.28 kg/ha 0.28 kg/ha 0.28-0.55 kg/ha 1.0 L/ha 0.56 L/ha 0.56-1.1 L/ha	Include 2,4-D or the lower rate of MCPA if mustards are present. Use the higher rate of MCPA if hempnettle is present. Do not use the 2,4-D mixture on oats and only on barley at the 4- to 5-leaf stage.
Lady's-thumb, wild buckwheat, mustards, many other broadleaf weeds, and top growth control of Canada thistle and sow-thistle	bromoxynil + 2,4-D* or MCPA* TORCH DS (450 g/L) or BROMOX C100 (450 g/L) + 2,4-D (500 g/L) or MCPA (500 g/L)	0.29 kg/ha 0.275-0.425 kg/ha 0.275-0.425 kg/ha 0.625 L/ha 0.625 L/ha 0.56-0.85 L/ha 0.56-0.85 L/ha	Do not use the 2,4-D mixture on oats. Use the 2,4-D mixture on spring wheat or barley when the crop is in the 3- to 5-leaf stage. Use the MCPA mixture when the crop is in the 2- to 5-leaf stage.
Many broadleaf weeds including hempnettle	bromoxynil/MCPA* (1:1) + MCPA* BUCTRIL M (560 g/L) or SABRE (720 g/L) + MCPA (500 g/L)	0.56 kg/ha 0.28 kg/ha 1.0 L/ha 0.78 L/ha 1.1 L/ha	Addition of MCPA will improve hempnettle control.
Many broadleaf weeds including lady's-thumb, wild buckwheat, hempnettle and corn spurry	cyanazine/MCPA (1.2) BLAGAL (375 g/L)	0.84 kg/ha 2.25 L/ha	Use when weeds are in the 2- to 4-leaf stage and the crop is in the 2- to 5-leaf stage. May cause temporary yellowing of the lower leaves of the crop plants.
	linuron + MCPA (amine)* LOROX (50 WP) or LOROX 480L (480 g/L) + MCPA (amine) (500 g/L)	0.21 to 0.28 kg/ha + 0.42 to 0.56 kg/ha 0.42 to 0.55 kg/ha or 0.42 to 0.55 L/ha 0.85 to 1.1 L/ha	Apply when weeds are in the 1- to 4-leaf stage and cereals are in the 2- to 4-leaf stage. May cause temporary yellowing of the lower leaves of the crop plants.

SPRING WHEAT, OATS and BARLEY NOT UNDERSEEDED to FORAGE CROPS (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Many broadleaf weeds, Canada thistle and perennial sow-thistle	2,4-DB* 2,4-DB (400 g/L) EMBUTOX E (400 g/L) EMBUTOX 625 (625 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.50 L/ha 2.75 to 3.50 L/ha 1.75 to 2.25 L/ha	Apply 2,4-DB at the 5-leaf to early flag stage of cereals.
	MCPB/MCPA (15:1) TROPOTOX PLUS	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply MCPB/MCPA from the 2-leaf stage to flag leaf stage of cereals.
Many broadleaf weeds including wild buckwheat, lady's-thumb, green and yellow foxtail	propanil/MCPA (3.6:1) STAMPEDE CM (460 g/L)	1.28 kg/ha 2.75 L/ha	Apply when the cereals are in the 2- to 5-leaf stage and weeds are in the 1- to 4-leaf stage. Propanil/MCPA may cause crop yellowing or leaf tip burn but these effects normally disappear in 10 to 14 days.
Emerged annual grasses, including wild oats in spring wheat and barley. Do not use on tame oats	diclofop-methyl HOE-GRASS 284 (284 g/L)	0.7-0.8 kg/ha 2.5-2.8 L/ha	Apply when the annual grasses are in the 1- to 5-leaf stage. The higher rate (2.8 L/ha) must be used to control wild oats in the 4-5 leaf stage. Hoe-Grass must only be applied in the 1- to 4-leaf stage of barley and prior to tillering (usually not later than 21 days after emergence of the crop). Application beyond the 4-leaf stage or after tillering may result in barley damage. Do not use if rain is expected within 1 hour after application. Apply herbicides for broadleaf weed control at least 4 days before or after diclofop-methyl application. For control of many broadleaf weeds, bromoxynil (TORCH DS, PARDNER, or BROMOX C100) may be added to Hoe-Grass. Consult the labels for complete mixing instructions.
Wild oats in spring barley and spring wheat. Do not use on tame oats	triallate AVADEX BW (400 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha	For wheat, triallate must be applied after planting and worked into the soil to kill wild oats. For barley, triallate can be applied before or after planting and must be worked into the soil. Consult the label for specific instructions on how to work the herbicide into the soil. Use the higher rate on heavier soils.
Wild oats in barley and spring wheat. Do not use on tame oats	difenzoquat AVENGE 200C (200 g/L)	07 to 0.85 kg/ha 3.5 to 4.25 L/ha	Use the lower rate of difenzoquat if the wild oat stand is less than 200 plants per m^2. Apply when the wild oats are in the 3- to 5-leaf stage. Do not use when the plants are wet or if rain is expected within 6 hours. For control of many broadleaf weeds, Avenge can be tank mixed with 2,4-DB* or bromoxynil (Torch DS, Pardner, Bromox C100, or bromoxynil/MCPA [Buctril M, Brominal M, Bromox 450, Sabre]). Consult the labels for complete mixing instructions.
Wild oats in spring wheat	flamprop-methyl MATAVEN (150 g/L)	0.52 kg/ha 3.48 L/ha	Apply when the wild oats are in the 3- to 5-leaf stage, before the wheat has more than 6 leaves. Do not use on Selkirk.
Emerged Canada thistle and perennial sow-thistle	AMITROLE-T AMITROLE-T (240 g/L)	3.4 to 4.6 kg/ha 14.0 to 19.0 L/ha	Apply after harvest to emerged actively growing weeds. Wait 10 to 14 days after spraying before working the area.

Emerged green foxtail in spring-seeded oats and barley	sodium TCA NaTA Grass Killer Pellets (85 SG)	1.06 to 2.3 kg/ha 1.25 to 2.75 kg/ha	Use only the low rate on barley. Apply when the foxtail is in the 1- to 3-leaf stage and the crop is in the 2- to 4-leaf stage. Do not use on cereals seeded less than 7.5 cm deep. May be mixed with BUCTRIL M, MCPA or 2,4-D amine for control of broadleaf weeds.
Emerged quackgrass	AMITROLE-T AMITROLE-T (240 g/L)	4.6-9.0 kg/ha 19-37.5 L/ha	Apply after harvest when regrowth is 15-20 cm tall. Plow when the quackgrass becomes white or purple (about 3 weeks after treatment).
Emerged quackgrass	dalapon DOWPON M (74SP) BASFAPON (74SP)	13.0 kg/ha 17.5 kg/ha 17.5 kg/ha	Apply to actively growing quackgrass foliage in the fall. Wait at least 10 days before working the area.
Emerged quackgrass	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply in 200-300 L of water per hectare in the previous fall or in the spring before the crop is planted. Other herbicides are necessary for annual weed control in the crop. More than one season control is obtained at these rates. See "Notes on Chemicals" for further details.
One season control of emerged quackgrass	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	For season-long control apply in the fall previous to the spring crop. Apply in 50-100 L per hectare water using flat fan nozzles. Use only in annual cropping systems.
	glyphosate + surfactant ROUNDUP (356 g/L) + FRIGATE	0.84 kg/ha 0.5 L/100 L 2.35 L/ha 0.5 L/100 L	For season-long control apply in the fall previous to the spring crop. Apply in 200 L water per hectare. Use only in annual cropping systems.
Spot treatments on emerged milkweed, field bindweed, Canada thistle and common tansy	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply when field bindweed has reached full bloom, Canada thistle, milkweed and common tansy are in the bud to full bloom stage. Emerged cereals will be killed by this treatment. To eliminate the possibility of residues in the crop, apply before the cereals have started to show heads.

SPRING WHEAT, OATS and BARLEY NOT UNDERSEEDED to FORAGE CROPS (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
After harvest treatment to regrowth of Canada thistle, field bindweed and other perennial broadleaf weeds	glyphosate ROUNDUP (356 g/L)	3.25 kg/ha 9.1 L/ha	Apply to actively growing weed foliage. Wait at least 5 days after application before working the area.
	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.2 kg/ha 3.0 L/ha 2.5 L/ha	Apply to actively growing weed foliage at least 2 weeks before a killing frost. Wait at least 3 weeks after application before working the area. Plant only cereals, soybeans or field corn in the year after application.
	2,4-D/mecoprop/ dicamba KIL-MOR (485 g/L)	0.53 to 0.82 kg/ha 1.1 to 1.75 L/ha	Apply to actively growing weed foliage. Wait at least 5 days after application before working the area.

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

TABLE 2A. SPRING CEREAL HERBICIDE WEED CONTROL RATINGS

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (eg. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	CROP			Annual Broad Leaves								Annual Grasses					Perennials		
		spring wheat	spring barley	oats	corn spurry	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	buckwheat, wild	hempnettle	barnyard grass	foxtail, green	foxtail, yellow	old witchgrass	wild oats	bindweed, field	sow-thistle	thistle; Canada
2,4-D amine	2,4-D[1]	*	*	*	P	P	E	E	E	E	F	P	P	P	P	P	P	F	G	F
MCPA	MCPA[1]	*	*	*	F	P	E	E	E	E	P	G	P	P	P	P	P	F	G	G
bromoxynil	bromoxynil[1]	*	*	*	P	E	E	G	G	G	E	P	P	P	P	P	P	F	F	F
2,4-DB	2,4-DB[1]	*	*	*	P	P	E	F	E	E	G	P	P	P	P	P	P	G	E	E
dicamba	BANVEL	*	*	*	E	G	E	F	E	E	E	F	P	P	P	P	P	G[2]	G[2]	G[2]

MCPB/MCPA (15:1)	TROPOTOX PLUS	*	*	*	P	P	E	E	E	G	P	G	P	P	P	P	P	G	E	E
dichlorprop/2,4-D	ESTAPROP	*	*		P	G	E	E	E	E	G	F	P	P	P	P	P	F	G	G
dicamba + 2,4-D	BANVEL + 2,4-D[1]	*	*		E	G	E	E	E	E	E	P	P	P	P	P	P	G^2	G^2	G^2
dicamba + MCPA	BANVEL + MCPA[1]	*	*	*	E	G	E	E	E	E	E	P	P	P	P	P	P	G^2	G^2	G^2
dicamba/MCPA	DYVEL	*	*	*	E	G	E	E	E	E	E	G	P	P	P	P	P	G^2	G^2	G^2
dicamba/2,4-D/mecoprop	KIL-MOR	*	*	*		G	E	E	E	E	E	G	P	P	P	P	P	G^2	G^2	G^2
dicamba/MCPA/mecoprop	TARGET	*	*	*		G	E	E	E	E	E	G	P	P	P	P	P	G^2	G^2	G^2
linuron + MCPA	LOROX plus MCPA[1]	*	*	*	E	E	E	E	E	E	E	E					P			
cyanazine/MCPA	BLAGAL	*	*	*	E	E	E	E	E	E	E	E					P			
propanil/MCPA	STAMPEDE CM	*	*	*		G	E	E	E	E	G			G	G		P	F	F	F
bromoxynil/MCPA (1:1)	Bromoxynil/MCPA[1]	*	*	*	P	E	E	E	G	E	E	F	P	P	P	P	P	F	F	F
bromoxynil + MCPA	Bromoxynil[1] + MCPA[1]	*	*	*	F	E	E	E	E	E	E	G	P	P	P	P	P	F	F	F
bromoxynil + 2,4-D	Bromoxynil[1] + 2,4-D[1]	*	*		P	E	E	E	G	E	E	F	P	P	P	P	P	F	F	F
bromoxynil/MCPA (1:1) + MCPA	Bromoxynil/MCPA[1] + MCPA[1]	*	*	*	F	E	E	E	E	E	E	G	P	P	P	P	P	F	G	G
bromoxynil/MCPA (1:1) + TCA	BUCTRIL M + NaTa Grass Killer Pellets		*	*	P	E	E	E	G	E	E	F	P	G	F	P	P	F	F	F
bromoxynil/MCPA (1:1) + difenzoquat	Bromoxynil/MCPA[1] + AVENGE 200 C		*		P	E	E	E	G	E	E	F	P	P	P	P	E	F	F	F
bromoxynil + difenzoquat	Bromoxynil + AVENGE 200 C		*		P	E	E	G	G	G	E	P	P	P	P	P	E	F	F	F
diclofop-methyl + bromoxynil	HOEGRASS 284 + bromoxynil[1]	*	*		P	E	E	G	G	G	E	P	G	G	G	G	E	F	F	F
TCA	NaTa Grass Killer Pellets		*	*	P	P	P	P	P	P	P	P		G			P	P	P	P
TCA + 2,4-D	NaTa Grass Kill Pellets + 2,4-D		*	*	P	P	E	E	E	E	F	P		G			P	F	G	F
TCA + MCPA	NaTa Grass Killer Pellets + MCPA[1]		*	*	F	P	E	E	E	E	P	G		G			P	F	G	G
triallate	AVADEX BW	*	*		P	P	P	P	P	P	P	P	P	P	P	P	E	P	P	P
diclofop-methyl	HOEGRASS 284	*	*		P	P	P	P	P	P	P	P	G	G	G	G	E	P	P	P
flamprop-methyl	MATAVEN	*			P	P	P	P	P	P	P	P	P	P	P	P	E	P	P	P

[1] *Various formulations available, see Table 1.*
[2] *More complete control can be obtained with treatment of actively growing foliage after harvest.*
* *Can be used on this crop.*

WINTER WHEAT and FALL RYE

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Many broadleaf annual and winter annual weeds including pepper-grass, shepherd's purse and stink-weed (pennycress)	2,4-D amine* 2,4-D (500 g/L) or MCPA amine or sodium* MCPA (500 g/L)	0.35 to 0.55 kg/ha 0.7 to 11.1 L/ha or 0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	Treat in the spring when the crop growth begins until the early shotblade stage. For control of winter annuals apply early before flower buds appear on the weeds.
Many broadleaf annual weeds	bromoxynil PARDNER (280 g/L)	0.28 to 0.34 kg/ha 1.0 to 1.2 L/ha	Winter wheat may be treated from the 2- to 4-leaf stage in the fall or from the time growth begins to early-flag-leaf stage in the spring. More effective on winter annuals when applied as a fall treatment.
	bromoxynil TORCH DS (450 g/L)	0.34 kg/ha 0.75 L/ha	Apply in the spring from the time growth begins to the early flag leaf stage. Apply in 100 L of water per hectare. Controls spring annual weeds only.
	bromoxynil/MCPA BROMOX 720M (720 g/L) SABRE (720 g/L)	0.56 kg/ha 0.78 L/ha 0.78 L/ha	Apply in the spring from the time growth begins to the early flag leaf stage.
Many broadleaf annual and winter annual weeds	bromoxynil/MCPA (1:1) BUCTRIL M (560 g/L)	0.56 kg/ha 1.0 L/ha	Winter wheat may be treated from the 2- to 4-leaf stage in the fall or from the 2- to early-flag leaf-stage in the spring.
Many broadleaf annual and winter annual weeds, Canada thistle and perennial sow-thistle in winter wheat	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	0.11 to 0.14 kg/ha 0.28 to 0.35 L/ha 0.23 to 0.29 L/ha	Apply in the spring when the crop is 15 to 25 cm tall before the shotblade stage. Can be used with 2,4-D or MCPA amine 0.42 kg/ha (**.84 L/ha of 500 g/L formulations)***. The addition of 2,4-D or MCPA will give improved control of pepper-grass, shepherds' purse and pennycress. DO NOT USE ON FALL RYE.
Many broadleaf annual and winter annual weeds, Canada thistle and perennial sow-thistle in winter wheat	dicamba/2,4-D/mecoprop KIL-MOR (485 g/L)	0.41-0.53 kg/ha 0.85-1.1 L/ha	Apply in early spring when winter annual weeds are in the rosette stage. Apply before the crop is more than 30 cm high (top leaf extended).
	dicamba/MCPA/mecoprop TARGET (400 g/L)	0.40-0.60 kg/ha 1.0-1.5 L/ha	Apply in spring before the crop is more than 30 cm high (top leaf extended) Winter annuals should be sprayed as soon as new growth starts. Apply when other weeds are in the 2-3 leaf stage.
	dicamba/MCPA (1:4) DYVEL (420 g/L)	0.5 kg/ha 1.25 L/ha	Apply to winter wheat in the spring when weeds have emerged and the crop is 15 to 25 cm tall before the shotblade stage.

Many broadleaf annual and winter annual weeds	dichlorprop/2,4-D (1:1) ESTAPROP (600 g/L)	1.1 kg/ha 1.75 L/ha	Apply in early spring to emerged weeds. May be used until cereals are up to the flag leaf stage.
Emerged loose silky bentgrass in the fall	diclofop-methyl HOE-GRASS 284 (284 g/L)	1.0 kg/ha 3.5 L/ha	Apply in the fall to loose silky bentgrass at the 1 to 4-leaf stage in winter wheat or fall rye.

WINTER WHEAT AND FALL RYE UNDERSEEDED TO CLOVERS

Many broadleaf annual and winter annual weeds in wheat and rye underseeded to red, alsike, white and ladino clovers	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in the spring when the cereal crop is in the 2-leaf to flag leaf stage, and the weeds are small and actively growing. Legumes should be in the 1- to 3-trifoliate stage. Use 150 to 200 L/ha of spray.
	MCPA MCPA SODIUM SALT 300 (300 g/L) or METHOXONE SODIUM 300 (300 g/L)	0.3 kg/ha 1 L/ha 1 L/ha	Apply in the spring when crop growth commences until early shotblade stage. Treat when the legumes are in an early stage of development and covered by a canopy of weeds and crop. Apply in 180-240 L of water/hectare.

**Additional formulations are available. Use rates that give comparable amounts of active ingredients. See Table 1.*

TABLE 2B. WINTER WHEAT AND FALL RYE HERBICIDE WEED CONTROL RATINGS

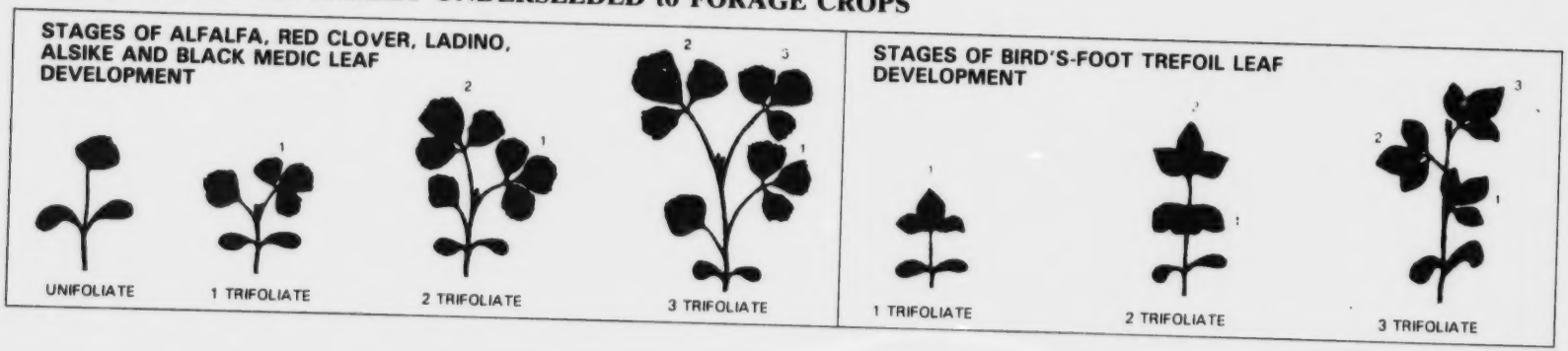
The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor applications) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Annual Broad Leaves								Winter Annuals			Perennials			Grasses			
		corn spurry	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	buckwheat, wild	hempnettle	stinkweed	shepherd's purse	chickweed	bindweed, field	sow-thistle	thistle; Canada	wild oats	foxtails	barnyard grass	quack grass
2,4-D	2,4-D[1]	P	P	E	E	E	E	F	P	E	E	P	F	G	F	P	P	P	P
MCPA	MCPA[1]	F	P	E	E	E	E	P	G	E	E	P	F	G	G	P	P	P	P
MCPB/MCPA (15:1)	TROPOTOX PLUS	P	P	E	E	E	G	P	G	E	E	P	G	E	E	P	P	P	P
dichlorprop/2,4-D	ESTAPROP	P	G	E	E	E	E	G	F	E	E	P	F	G	G	P	P	P	P
dicamba	BANVEL	E	G	E	P	E	E	E	F	P	P	G	G	G	G	P	P	P	P
dicamba/2,4-D/mecoprop	KIL-MOR		G	G	E	E	E	E	G	E	E	G	G	G	G	P	P	P	P
dicamba/MCPA/mecoprop	TARGET		G	G	E	E	E	E	G	E	E	G	G	G	G	P	P	P	P
dicamba + MCPA	BANVEL + MCPA[1]	E	G	E	E	E	E	E	P	E	E	G	G	G	G	P	P	P	P
dicamba + 2,4-D	BANVEL + 2,4-D[1]	E	G	E	E	E	E	E	P	E	E	G	G	G	G	P	P	P	P
bromoxynil	PARDNER[2]	P	E	E	G	G	G	E	P	G	G	P	F	F	F	P	P	P	P
bromoxynil/MCPA	BUCTRIL M[2]	P	E	E	E	G	E	E	F	E	E	P	F	F	F	P	P	P	P
bromoxynil	BROMOXYNIL[1]	P	E	E	G	G	G	E	P	G	G	P	F	F	F	P	P	P	P
bromoxynil + MCPA	BROMOXYNIL[1] + MCPA[1]	F	E	E	E	G	E	E	F	E	E	P	F	F	F	P	P	P	P
glyphosate	ROUNDUP	P	P	P	P	P	P	P	P	P	P	P	E	E	E	P	P	P	E

[1] *Various formulations are available; consult Table 1.*
[2] *Can be used as a fall or spring treatment. All other treatments except glyphosate are for spring treatment only. Glyphosate can be used only before planting or after harvest.*

SPRING WHEAT, OATS and BARLEY UNDERSEEDED to FORAGE CROPS



WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	**REMARKS** (For more information, see "Notes on Chemical" section.)
Many broadleaf weeds in cereals seeded down to alfalfa, bird's-foot trefoil, alsike or ladino clovers and grasses	2,4-DB 2,4-DB (400 g/L) EMBUTOX (400 g/L) EMBUTOX 625 (625 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha 2.75 to 3.5 L/ha 1.75 to 2.25 L/ha	Apply in 150 to 200 L water per hectare when the legumes are in the 1- to 3-trifoliate stage. Wild mustard plants are not usually controlled if sprayed when they are beyond the 4-leaf stage. Red clover will be damaged by 2,4-DB.
	2,4-DB + MCPA* EMBUTOX 625 (625 g/L) COBUTOX (400 g/L) + MCPA (500 g/L)	0.8 kg + 35 g/ha 1.25 L/ha 2 L/ha + 0.07 L (70 mL)/ha	The addition of MCPA gives better control of common mustard than 2,4-DB alone. Apply in 150 to 200 L water per hectare. Apply when the legumes are in the 1- to 3-leaf stage.
Many broadleaf weeds in cereals seeded down to red; alsike and ladino or white dutch clovers and grasses	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in 150 to 200 L water per hectare when legumes are in the 1- to 3-trifoliate leaf stage.
Common mustard and some other small broadleaf weeds in cereals underseeded to red clover	MCPA MCPA SODIUM SALT 30 (300 g/L) METHOXONE SODIUM 300 (300 g/L)	0.3 to 0.45 kg/ha 1 to 1.5 L/ha 1 to 1.5 L/ha	Treat at an early stage of development of the clover when it is **covered by a canopy of weeds and crop**. Apply in 180 to 240 L of water/hectare. The lower rate may not kill ragweed.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Many emerged broadleaf weeds in cereals seeded to grasses only	2,4-D* 2,4-D (500 g/L) or MCPA* MCPA (500 g/L)	0.28 to 0.42 kg/ha 0.56 to 0.84 L/ha or 0.28 to 0.56 kg/ha 0.56 to 1.12 L/ha	Apply when the forage grasses have at least 2 leaves and cereals are in the 2- to 5-leaf stage.
Emerged annual grasses in wheat, barley underseeded to alfalfa, red or sweet clover. Do not use on Tame oats	diclofop-methyl HOE-GRASS 284 (284 g/L)	0.7-0.8 kg/ha 2.5-2.8 L/ha	Apply when the annual grasses are in the 1- to 5-leaf stage. The higher rate (2.8 L/ha) must be used to control wild oats in the 4-5 leaf stage. Diclofop-methyl must only be applied in the 1-4 leaf stage of barley and prior to tillering (usually not later than 21 days after emergence of the crop). Application beyond the 4-leaf stage or after tillering may result in barley damage. Do not use if rain is expected within 1 hour after application. Apply herbicides for broadleaf weed control at least 4 days before or after diclofop-methyl application.
Emerged wild oats in barley and spring wheat underseeded to forage crops. Do not use on Tame oats	difenzoquat AVENGE 200C (200 g/L)	0.7-0.85 kg/ha 3.5-4.25 L/ha	Apply when the wild oats are in the 3-5 leaf stage. Use the lower rate when the wild oat stand is less than 200 plants/m^2. For control of many broadleaf weeds, AVENGE 200 L can be tank mixed with 2,4-DB*.
Emerged quackgrass	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply in 200-300 litres of water per hectare in the previous fall or in the spring before the crop is planted. Apply to actively growing quackgrass with at least 4 new leaves on each emerged shoot. In the fall remove crop refuse but DO NOT till prior to application. Fall or spring tillage prior to spring application may reduce control. Wait at least 5 days after application before working the area, and for maximum control it is advisable to till before the quackgrass turns completely brown. Rainfall within 6 hours after application may reduce quackgrass control. Heavy frosts may reduce control. Other herbicides are necessary for annual weed control in the crop. More than one season control is obtained at these rates.
One season control of emerged quackgrass	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	For season-long control apply in the fall previous to the spring crop. Apply in 50-100 L water per hectare using flat fan nozzles. Use only in annual cropping systems.
	glyphosate + surfactant ROUNDUP (356 g/L) + FRIGATE	0.84 kg/ha 0.5 L/100 L 2.35 L/ha 0.5 L/100 L	For season-long control apply in the fall previous to the spring crop. Apply in 200 L water per hectare. Use only in annual cropping systems.

Emerged milkweed, field bindweed, Canada thistle and common tansy	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply when field bindweed has reached full bloom, and other weeds are in the bud to full bloom stage. Emerged crop plants will be killed by this treatment. Do not apply after the cereals have started to show heads. Do not harvest forage from the treated areas until the treated plants have turned brown. Apply at least 6 hours before rain.

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

FORAGE LEGUMES (DIRECT SEEDED)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Nutsedge and many germinating grass and broadleaf weeds	EPTC EPTAM (800 g/L)	3.4 kg/ha 4.25 L/ha	Before seeding pure stands of alfalfa or bird's-foot trefoil apply to a dry soil surface and incorporate into the soil immediately. Some broadleaf weeds such as ragweed, mustards, and pigweed frequently escape.
Germinating annual grasses and good control of lamb's-quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 kg/ha 1.2 to 2.4 L/ha	Incorporate into the soil before seeding pure stands of alfalfa.
Many emerged broadleaf weeds	2,4-DB* 2,4-DB (400 g/L) EMBUTOX (400 g/L) EMBUTOX 625 (625 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha 2.75 to 3.5 L/ha 1.75 to 2.25 L/ha	Apply in 150 to 200 L water per hectare, when alfalfa, bird's-foot trefoil or clovers are in the 1- to 3-leaf stage. 2,4-DB usually suppresses legume growth for a period of 2 to 3 weeks. Under drought, high temperature or other stress conditions, 2,4-DB may severely injure legumes.
	2,4-DB + MCPA EMBUTOX 625 (625 g/L) COBUTOX (400 g/L) + MCPA (500 g/L)	0.8 kg/ha + 35 g/ha 1.25 L/ha 2 L/ha + 0.07 L (70 mL)/ha	The addition of MCPA gives better control of common mustard than 2,4-DB alone. Apply in 150 to 200 L water per hectare. Apply when the legumes are in the 1- to 3-leaf stage.
Many emerged broadleaf weeds in clovers (except sweet clover) and grasses	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in 150 to 200 L water per hectare when legumes are in the 1- to 3-leaf stage. Clovers may be suppressed for a period of 2 to 3 weeks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Emerged green and yellow foxtail, barnyard grass, wild oats, old witch grass and volunteer corn	diclofop-methyl HOE-GRASS 284 (284 g/L)	0.7-0.8 kg/ha 2.5-2.8 L/ha	Use on alfalfa, red or sweet clover when the grass weeds are in the 1- to 4-leaf stage. Do not apply if rain is expected within 1 hour after treatment. Broadleaf control herbicides must be applied at least 4 days before or after diclofop-methyl. Do not feed forages in the year of seeding after treatment with diclofop-methyl.
Many annual grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	3.0 kg/ha 4.0 kg/ha 4.0 kg/ha	Use on pure stands of alfalfa or bird's-foot trefoil where the treated foliage is not fed to meat or dairy animals in the same crop year after application. Can be mixed with 2,4-DB and used at the same stage of legume growth.
Emerged quackgrass	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply before the crop is planted when the quackgrass has at least 4 new leaves on each emerged shoot. Wait at least 5 days after application before working the area, and for maximum control it is advisable to till before the quackgrass turns completely brown. Apply at least 6 hours before rain. Tillage such as fall plowing, spring plowing, discing or mowing prior to application of this product will reduce effectiveness. More than one season control is expected at these rates.

Additional formulations are available. Use rates that give comparable amounts of active ingredients. See Table 1.

ESTABLISHED FORAGE LEGUMES

Canada thistle and chicory	2,4-DB* 2,4-DB (400 g/L) EMBUTOX E (400 g/L) EMBUTOX 625 (625 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha 3.5 to 4.25 L/ha 2.25 to 2.75 L/ha	For pure stands or mixtures containing alfalfa or bird's-foot trefoil apply as spot treatment, or on regrowth after cutting or grazing. Apply in 150 to 200 L water per hectare.
	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.7 kg/ha 4.25 L/ha	For pure stands or mixtures containing red and alsike clovers. Apply as spot treatment, or on regrowth after cutting or grazing. Aply in 150 to 200 L water per hectare.
Yellow rocket and winter weeds in red clover, alfalfa and bird's-foot trefoil	2,4-DB* 2,4-DB (400 g/L) EMBUTOX E (400 g/L) EMBUTOX 625 (625 g/L)	1.4 kg/ha 3.5 L/ha 3.5 L/ha 2.25 L/ha	Apply on actively growing weeds after cutting or grazing in September or October.

To prevent establishment of many weeds in established alfalfa and bird's-foot trefoil	simazine** PRINCEP (80 WP) SIMADEX (500 g/L)	1.1 kg/ha 1.3 kg/ha 2.2 L/ha	Do not use SIMADEX on alfalfa. Apply in September to November before freeze up. This treatment will also prevent legume seedlings from establishing for approximately 8 months. Do not use in the fall before seeding another crop. Do not apply paraquat within 1 year after simazine application. Do not apply to the same field for more than 3 consecutive years. Allow 30 days between applications and grazing cattle or sheep.
To control seeding dandelions and many other seedling weeds in pure stands of alfalfa	metribuzin SENCOR (500 g/L)	0.5 to 1.0 kg/ha 1.0 to 2.0 L/ha	Apply in early spring or late fall when the alfalfa is dormant.
To control seeding dandelions and many other seedling weeds in pure stand of alfalfa	terbacil SINBAR (80 WP)	0.56 to 1.2 kg/ha 0.7 to 1.5 kg/ha	For use on alfalfa establishment at least 1 year. Apply after alfalfa is dormant in the fall or before new growth starts in the spring. Use the higher rate on clay or clay loam soils and the lower rate on sands or loams. Do not seed treated area to any crop within 2 years after the last terbacil treatment.
Suppression of annual grasses, red and alsike clovers in bird's-foot trefoil and alfalfa fields	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	3.0 kg/ha 4.0 kg/ha 4.0 kg/ha	Apply in the fall when growth is about 15 cm high. This treatment may reduce the forage yield of some alfalfa varieties in the year after application. Do not feed or graze foliage treated with dalapon to meat or dairy animals during the crop year of application.
Control or suppression of grasses and annual weeds in bird's-foot trefoil and alfalfa fields	paraquat GRAMOXONE (200 g/L)	0.56 to 1.1 kg/ha 2.8 to 5.5 L/ha	Apply to trefoil seed fields when the crop is 8.15 cm high in the spring. Apply to alfalfa or trefoil forage fields within 5 days after cutting. Slow recovery and some stand reduction has been observed under conditions of drought or high temperatures. Do not use in the spring after treatment with simazine.
Control of quackgrass and many other grasses in alfalfa and bird's-foot trefoil	propyzamide KERB (50 WP)	1.1 to 1.63 kg/ha 2.25 to 3.25 kg/ha	Apply in late September to early November before the soil freezes. Do not apply dalapon in the same fall as propyzamide.
Emerged milkweed, field bindweed, Canada thistle and common tansy	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply as spot treatment when the field bindweed has reached full bloom and other weeds are in the bud to full bloom stage. Do not graze or harvest forage from treated spots until the treated plants turn brown.
Emerged Canada thistle and perennial sow-thistle	amitrole-T AMITROLE-T (240 g/L)	3.36-4.56 kg/ha 14.0-19.0 L/ha	Apply after the final harvest in the final year of the forage. apply when thistle regrowth is 15-20 cm tall. Wait 2 weeks before plowing. Do not graze or otherwise harvest the forage after spraying.

**SIMADEX (80 WP) equivalent rate is 1.3 kg/ha.

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

PASTURES (Mostly Grasses)

Overgrazing tends to thin the grass stand and allows the establishment of weeds. Undergrazing allows weeds like wild carrot to form and spread seed. Timely mowing can prevent the ripening of weed seeds and reduce the distance these seeds spread with the wind.

Chemicals are available to control most of the troublesome weeds in grass pastures and these can give faster kill of established weeds than any other management practice. A chemical may have to be applied more than once to kill established perennial weeds and the new crop of weeds emerges through a thin grass stand. A poor grass stand can be improved by using a combination of chemicals, fertility and grazing management.

Chemical weed control should extend into fencerows and other areas around the pasture to keep these areas from becoming sources of weed seeds.

Generally, clovers are severely damaged by chemical treatments. However, white clover and black medic show some resistance or reestablish quickly.

Consult the label in regard to the period of time to keep livestock out of the treated area. With most of the chemicals this will be a period of about 5 days, but with AMITROLE or AMITROLE-T it is 6 to 8 months. After glyphosate application wait until the treated plants turn brown before starting to graze the area.

Care should be taken to prevent grazing where poisonous plants (water hemlock, chokecherry, etc.) may be made more attractive to livestock after the chemical treatment. It is a good practice to prevent grazing on the field for at least a week after spraying to reduce the chances of the livestock picking up harmful plants.

Apply chemical treatments in at least 200 L of water per hectare and increase this rate if it is necessary to contact weeds through a thick volume of vegetation.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Blueweed	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as low-volatile ester as late spring or early fall application.
Brush	**See pages 154 to 156**		
Burdock	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as low-volatile ester in fall or spring. This treatment will be most effective on first-year rosettes.
Buttercup	MCPA* MCPA (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in June and again in early September.
Canada thistle, field bindweed	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.2 kg/ha 3.0 L/ha 2.5 L/ha	Apply in late spring when the thistles are in the bud stage and the bindweed is flowering. Wait 14 days between treatment and harvest or grazing for dairy animals. Meat animals may graze or feed treated pastures 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.

Canada thistle, field bindweed	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.7 kg/ha 4.25 L/ha	This treatment has some safety on forage legumes. Use 150 to 200 L water per hectare.
	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.7 to 12.0 L/ha	Apply as spot treatment when the thistles are in the bud to full bloom stage, and the bindweed is flowering.
Chicory	2,4-D (LV ester)* 2,4-D (500 g/L)	0.84 kg/ha 1.7 L/ha	Apply in late spring.
Common tansy	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7.0 to 12.0 L/ha	Apply as a spot treatment when the tansy is in the bud to full bloom stage.
Dandelions	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in May or September.
Goat's-beard	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as early as possible on the second year's growth or early fall on the first year's growth.
	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	2.2 kg/ha 5.5 L/ha 4.6 L/ha	Apply when actively growing. Wait 14 days between treatment and harvest or grazing for dairy animals. Meat animals may graze or feed treated pastures 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.
Goldenrod	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in June.
	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.1 kg/ha 2.8 L/ha 2.1 L/ha	Apply when actively growing. Wait 7 days between treatment and harvest or grazing for dairy cattle. Meat animals may graze or feed treated pastures 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.
Hawkweeds	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 to 1.75 kg/ha 2.2 to 3.5 L/ha	Apply near the end of May and early September.

PASTURES (Mostly Grasses) (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Leafy spurge	TBA TBA — 4 GENERAL WEED KILLER (400 g/L)	11 to 22 kg/ha 28 to 56 L/ha	Apply to young growth. Residues may damage crops for a number of years.
	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	0.6 kg/ha 1.5 L/ha 1.25 L/ha	For top growth control apply when the weed is actively growing. No delay is required between treatment and harvest or grazing for dairy cattle. Meat animals may graze or feed treated pastures 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.
Milkweed	glyphosate ROUNDUP (356 g/L)	4.25 kg/ha 12.0 L/ha	Apply as a spot treatment when the milkweed is in the bud to bloom stage.
	amitrole-T AMITROLE-T (240 g/L)	4.5 kg/ha 19 L/ha	Spray to wet before flowering. Use spot treatments. Keep animals away from the treated area for 6 to 8 months.
	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as a late spring application emphasizing spraying of the undersides of leaves. This treatment kills top growth only.
Nodding, bull, and scotch thistle	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply late spring or early fall.
	2,4-DB* 2,4-DB (400 g/L) EMBUTOX E (400 g/L) EMBUTOX 625 (625 g/L)	1.7 kg/ha 4.25 L/ha 4.25 L/ha 2.75 L/ha	Apply late spring or early fall.
Ox-eye daisy	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 to 1.75 kg/ha 2.2 to 3.5 L/ha	Use two treatments, one in mid-June and the second in early September if there is sufficient growth.
Tansy ragwort	2,4-D (LV ester)* 2,4-D (500 g/L)	2.25 kg/ha 4.5 L/ha	Apply to rosettes in spring or fall. Retreatment will be necessary to control any new seedlings and regrowth.

Tansy ragwort	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.1 kg/ha 2.8 L/ha 2.1 L/ha	Apply when the tansy ragwort is actively growing. Wait 7 days between treatment and harvest or grazing for dairy cattle. Meat animals may graze or feed treated pasture 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.
Water hemlock	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in May or June.
Wild carrot	2,4-D (LV ester)* 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in early fall for first-year plants or early spring for second-year plants. If 2,4-D resistant strains are present mow to reduce seed spread.
	2,4-D amine* or LV ester* plus dicamba 2,4-D (500 g/L) plus BANVEL (400 g/L) BANVEL (480 g/L)	1.1 kg/ha plus 1.1 kg/ha 2.2 L/ha plus 2.8 L/ha 2.1 L/ha	Apply in early fall for control of first-year plants. Wait 7 days between treatment and harvest or grazing for dairy cattle. Meat animals may graze or feed treated pastures 30 days after dicamba application without restrictions on slaughter. If treated vegetation has been consumed by meat animals within 30 days of dicamba application, feed the animals with untreated diet for 30 days before slaughter.
Yellow rocket (winter cress)	2,4-D (LV ester)* 2,4-D (500 g/L)	0.84 to 1.1 kg/ha 1.7 to 2.2 L/ha	September, October or in early May before flowering. Mow if the plants are in the flowering stage.

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

PASTURE RENOVATION WITH BIRD'S-FOOT TREFOIL

The introduction of this legume into a pasture requires control of competition from weeds and forage grasses for the first 2 to 4 months after the legume seed begins to germinate. Control of established perennial weeds should start at least one year before the legume seeding operation, using treatments recommended in the previous section of this publication. If the field cannot be plowed and worked to prepare a seedbed, one of the following chemical treatments can be used to suppress the sod.

Grass suppression	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	4.0 kg/ha 5.5 kg/ha 5.5 kg/ha	Apply in September. Broadcast seed and fertilizer in March. Do not feed forage to meat or dairy animals in the fall after application.
Grass and broadleaf suppression	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Broadcast seed and fertilizer in mid-April. Apply paraquat in early May.
Kill or suppression of grasses and broadleaf plants	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply when the forage grasses have at least 2 leaves.

The success of these programs depends on many management factors such as inoculation of the trefoil seed, and control of fertility and grazing. Consult local agricultural authorities for more information about pasture renovation.

FIELD
CROPS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
FLAX-LINSEED			
Lady's-thumb, wild buckwheat and many other emerged broadleaf weeds	bromoxynil TORCH DS (450 g/L)	0.28 kg/ha 0.625 L/ha	Apply before the weeds are developed beyond the 4-leaf stage when flax is 8 to 15 cm high. Some burn of flax leaves may be noted but new growth usually appears quickly.
Mustards, lady's-thumb, wild buckwheat and many other emerged broadleaf weeds	bromoxynil/MCPA* (1:1) BUCTRIL M (560 g/L) SABRE (720 g/L)	0.56 kg/ha 1.0 L/ha 0.78 L/ha	Apply when the flax is 5 to 10 cm high before weeds have developed beyond the 4-leaf stage. Do not use if the daytime temperature is over 29°C.
	bromoxynil + MCPA* TORCH DS (450 g/L) + MCPA (500 g/L)	0.28 kg/ha 0.28 kg/ha 0.63 L/ha 0.56 L/ha	Apply when the flax is 5-10 cm high in 100 L of water per hectare. Do not use if the daytime temperature is over 29°C.
Mustard and many other emerged annual broadleaf weeds	MCPA* MCPA (500 g/L)	0.42 to 0.56 kg/ha 0.84 to 1.1 L/ha	Flax may be treated when 5 cm tall to bud stage. Best weed control is obtained if the application is made when the weeds are small (approx. 5 cm tall).
	2,4-D* 2,4-D (500 g/L)	0.35 kg/ha 0.70 L/ha	Treat when flax is 5 cm high to bud stage. Weeds should be small when sprayed (approx. 5 cm tall).
Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	1.1 kg/ha 2.25 L/ha 2 L/ha	Apply when flax is 5 cm or higher and weeds are small and actively growing. Top growth of nutsedge and Canada thistle are controlled and field bindweed may be suppressed by 2 applications of 1.75 L/ha (0.84 kg active/ha); 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Cool weather or drought may delay control. Reduce rate of oil concentrate to 1 L/ha under abnormally hot, humid or cool weather conditions. Otherwise, temporary crop injury may occur.
Emerged annual grasses, wild proso millet, wild oats, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha plus 2 L/ha	Flax is tolerant to sethoxydim at any stage of growth. apply sethoxydim to emerged grasses in the 1- to 6-leaf stage during active growth while the crop is small enough to permit thorough spray coverage. Apply in 50 to 200 L/ha water with 275 to 425 kPa pressure and flat fan nozzles angled forward 45°. Complete control is normally obtained 7 to 21 days after application. A second application may be necessary to control grasses that emerge after treatment.

Emerged quackgrass	sethoxydim POAST plus oil concentrate ASSIST	0.8 kg/ha 4.4 L/ha plus 4 L/ha	Thorough pre-planting tillage will ensure more uniform quackgrass emergence. Apply at the 1-3 leaf stage of actively growing quackgrass. Apply in 110-200 L/ha of spray solution. A maximum of 8 weeks control of quackgrass can be expected.
	sethoxydim POAST plus oil concentrate ASSIST plus technical grade ammonium sulfate or BASF Liquid Ammonium Sulphate	0.5 kg/ha 2.7 L/ha plus 2 L/ha plus 2 kg/ha or 4 L/ha	
Emerged annual broadleaf weeds and grasses	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST plus bromoxynil/MCPA* (1:1) BUCTRIL M (560 g/L) SABRE (720 g/L)	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha plus 2 L/ha 0.56 kg/ha 1.0 L/ha 0.78 L/ha	See sethoxydim and bromoxynil/MCPA instructions for details.
	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST plus MCPA amine or ester* MCPA (500 g/L)	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha 0.42 to 0.56 kg/ha 0.84 to 1.1 L/ha	See sethoxydim and MCPA instructions for details.
Annual grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	0.81 to 1.1 kg/ha 1.1 to 1.75 kg/ha 1.1 to 1.75 kg/ha	Apply before the grasses are beyond the 3-leaf stage. These chemicals may be combined with MCPA and MCPB + MCPA for broadleaf control.
Wild oats	triallate AVADEX BW (400 g/L)	1.7 to 2.2 kg/ha 4.25 to 5.5 L/ha	Triallate can be applied before or after seeding and must be worked into the soil to control wild oats. Consult the label for complete directions.
HARVEST AID			
Harvest-Aid to burn off weeds	diquat REGLONE (200/L) plus surfactant AGRAL 90	0.3-0.55 kg/ha 1.5-2.75 L/ha 1 L/1000 L	Apply by air in at least 20 L of water/ha when the crop is at 75% ball turn stage. Do not apply to immature crop. This application reduces dry-down time and eliminates the need for swathing.

**BROMOX 450 m (450 g/L) equivalent rate is 1.25 L/ha. BROMOX 720 (720 g/L) equivalent rate is 0.78.*

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

FIELD CROPS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
CANOLA (RAPESEED) — Spring Planted*			
Preplant Incorporated			
Germinating annual grasses and good control of lamb's-quarters and pigweed, including triazine-resistant species	trifluralin TREFLAN (545 g/L)	0.8 to 1.1 kg/ha 1.5 to 2.1 L/ha	
Postemergence			
Emerged annual grasses, wild proso millet, wild oats, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.15 to 0.3 kg/ha 0.8 to 1.6 L/ha plus 2 L/ha	Canola is tolerant to sethoxydim at any stage of growth. Complete control is normally obtained 7 to 21 days after application.
**Trifluralin and sethoxydim are registered for use on spring planted canola only. No herbicides are currently registered for use on winter rapeseed.*			
Harvest-Aid			
Harvest-aid and to burn off weeds	diquat + surfactant REGLONE (200 g/L) + AGRAL 90	0.3 to 0.55 1.5 to 2.75 L/ha 1 L/1000 L spray	Apply by air in at least 20 L of water/ha when crop is 60-75% seed turn (green or brown) stage. Do not apply to crop that is immature or beyond recommended stage of maturity. This application will burn off weeds, and reduce the incidence of pod shattering and eliminate the need for swathing. Commence combining not later than 14 days after application. For Argentine varieties Reglone should only be used to facilitate the harvest of a lodged crop. May be used on seed or commercial crops. Beware of drift to adjacent crops or plants.
CANOLA (RAPESEED) TRIAZINE TOLERANT			
Preplant Incorporated			
Germinating annual grasses and broadleaf weed including some triazine-resistant species	trifluralin TREFLAN (545 g/L) plus metribuzin (tank-mix) SENCOR (500 g/L)	0.8 to 1.1 kg/ha 1.5 to 2.1 L/ha plus 0.28 to 0.42 kg/ha 0.55 to 0.85 L/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed. Poor growing conditions can contribute to some crop injury which is usually temporary.

Preemergence

Wild mustard, triazine susceptible lamb's quarters and other broadleaves	atrazine ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.0 to 1.5 kg/ha 2.0 to 3.0 L/ha 1.1 to 1.7 kg/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed.
Germinating annual broadleaf weeds	Metribuzin SENCOR (500 g/L)	0.28 to 0.42 kg/ha 0.55 to 0.85 L/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed. Poor growing conditions can contribute to some crop injury which is usually temporary.

Postemergence

Wild mustard, triazine susceptible lamb's quarters and other broadleaves	atrazine ATRAZINE (500 g/L) ATRAZINE (90 WP) plus oil	.75 kg/ha 1.5 L/ha 0.8 kg/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed. Apply at the 2-leaf stage of the crop. Use 17 L/ha of an emulsifiable light mineral oil and 150-300 L of water per hectare.
Wild mustard, stinkweed and other annual broadleaf weeds	Cyanazine BLADEX (480 g/L)	1.44 kg/ha 3.0 L/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed. Apply when the crop and weeds are in the 1-4 leaf stage. Optimum weed control is achieved when weeds are small and actively growing.
Annual broadleaves, including wild mustard and stinkweed. Emerged annual grasses, proso millet, wild oats, volunteer corn and volunteer cereals	Cyanazine BLADEX (480 g/L) plus sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	1.44 kg/ha 3.0 L/ha plus 0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha + 2 L/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed. See additional notes on cyanazine and sethoxydim.
Many annual broadleaf weeds	Metribuzin SENCOR (500 g/L)	0.28 to 0.35 kg/ha 0.55 to 0.7 L/ha	This treatment is for use only on Triazine Tolerant Canola. Non Triazine Tolerant Canola will be killed. Poor growing conditions can contribute to some crop injury which is usually temporary.
Emerged annual grasses, proso millet, wild oats, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha + 2 L/ha	Triazine tolerant canola is tolerant to sethoxydim at any stage of growth. Complete control is normally obtained 7 to 21 days after application.

CORN, FIELD AND SWEET

Weed control in corn has become increasingly reliant upon chemicals. Although chemicals by themselves can be effective, cultivation, rotation and other cultural practices should not be forgotten. Any single method of weed control or the continuous use of the same chemicals can lead to the buildup of weeds resistant or tolerant to that control method. Triazine-resistant lamb's-quarters and pigweed have become a problem as a result of continuous corn and the repeated use of triazine herbicides. Rotation to other crops and/or other control methods will reduce the chance of new or unique weed infestations.

High speed (10 kph), shallow (2.5 to 3 cm) cultivation with the rotary hoe when corn is 7 to 8 cm in height will help to control small weed seedlings. This technique will not reduce herbicide action and may in some years enhance chemical weed control.

Inter-row cultivation may be required when weeds escape herbicide treatment. Weeds should be considered as escapes when they are 7 to 10 cm high. Cultivation should be shallow to prevent exposure of untreated soil and germination of new weed seeds.

Band treatment of chemical over the row will reduce costs by one-half to two-thirds depending on the row-spacing and width of band. Shallow inter-row cultivation will be required to control weeds between the bands.

Cultivation will give some control of established perennial weeds but may also help to spread them to previously uninfested areas. Machinery sanitation is important when moving from one field to another. Many perennials can be spread on tillage equipment (i.e. nutsedge). Where possible it is always a good idea to till fields with perennial weeds last. Custom operators should be particularly careful when moving from one farm to another. For additional information see OMAF Factsheet, Long-term Weed Control Planning, Agdex 641.

Sweet Corn Recommendations very closely parallel the recommendations for field corn. There are three differences that need to be noted: (1) the sensitivity of some sweet corn hybrids to 2,4-D; and, (2) no general recommendations for using preemergence linuron due to injury on some sweet corn hybrids. Where 2,4-D is being used beware of 2,4-D drift hazard. (See precautions in postemergence with 2,4-D section.) (3) Dicamba is not recommended for use on sweet corn because of crop injury.

Sweet corn most frequently is grown in areas where the crops in sequence are very sensitive to atrazine residues. Avoid using atrazine rates above 1.1 kg (active) per hectare **(2.2 L of (500g/L) or 1.2 kg of (90 WP) PRODUCT).** (See notes on atrazine residues for suggestions.)

Seed Corn Recommendations: Although most field corn recommendations are applicable to seed corn, there are inbreds which are susceptible to some chemicals. Check with the contracting company before applying any herbicide.

For information on specific weeds see Tables 3A to 3D and then refer to the appropriate section for details about herbicide treatment.

Preplanting

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass	amitrole-t AMITROL-T (240 g/L)	3.36 to 5.28 kg/ha 14 to 19 L/ha	Apply to actively growing quackgrass (15-20 cm high) in the fall or spring. Plow or thoroughly disk 10-14 days after application. Cultivation may be required when the corn is 12 to 15 cm.
	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in 200 to 300 L of water per hectare in the previous fall or in the spring before the crop is planted. Other herbicides are necessary for annual weed control in the crop. More than one season control is obtained at these rates.

	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	For season-long control of quackgrass apply in the fall or spring previous to the spring crop. Apply in 50-100 L per hectare of water using flat fan nozzle. Use only in annual cropping systems (follow other directions above).
	glyphosate ROUNDUP (356 g/L) plus surfactant FRIGATE	0.84 kg/ha 2.35 L/ha 0.5 L/100 L of spray solution 0.5 L/100 L of spray solution	For season-long control of quackgrass, apply in fall previous to spring crops. Apply in 200 to 300 L water per hectare. Use only in annual cropping systems.
Quackgrass and germinating annual broadleaf and grass weeds	amitrole-t AMITROL-T (240 g/L) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	2.22 kg/ha 9.25 L/ha plus 2.25 kg/ha 4.5 L/ha 2.50 kg/ha	Apply amitrole-t to actively growing quackgrass (15-20 cm high) in the spring, and plow or cultivate 7 days later, then plant to corn. Follow by an application of atrazine (see early postermergence section). Cultivation will provide added effectiveness.
Quackgrass, Canada thistle, and germinating annual broadleaf weeds and grasses	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	2.25 and 2.25 kg/ha 4.5 and 4.5 L/ha 2.50 and 2.50 kg/ha	Where this treatment is used, corn must be grown for two successive years. For quackgrass, apply the first 2.25 kg/ha (active) on foliage before plowing in the fall or spring. Best results will be obtained if the quackgrass is actively growing at the time of application and plowing is delayed 1 to 3 weeks after application. Shoots from deeply buried rhizomes may not emerge by the time the second application is made. Therefore, plowing deeper than 15 cm may reduce the effectiveness of this program. For Canada thistle, make the first application in the fall before plowing. Make the second application of 2.25 kg/ha after planting the corn as an early post-emergent spray in an oil-water emulsion of 17 L/ha of emulsifiable oil in 200-300 L/ha of water. To reduce the harmful effects of competition between quackgrass and the corn make the second application when the quackgrass is in the 2 to 4 leaf stage. Row cultivation will increase the effectiveness of this treatment.

**Additional formulations are available. See Table 1 and use rates that give comparable amounts of active ingredient.*

TABLE 3A. CORN HERBICIDE WEED CONTROL RATINGS, (PREPLANT OR SPLIT APPLICATIONS)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating E — Excellent G — Good F — Fair P — Poor			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
Treatment	**Trade Name**	**Method[1] of Application**	**buckwheat, wild**	**corn spurry**	**lady's-thumb**	**lamb's-quarters**	**mustards**	**nightshades**	**pigweeds**	**ragweeds**	**triazine resistant**	**velvetleaf**	**barnyard grass**	**crabgrass**	**fall panicum**	**foxtails**	**old witch grass**	**proso millet**	**bindweed, field**	**horsetail**	**milkweed**	**nutsedge**	**quackgrass**	**sow-thistle**	**thistle; Canada**	
amitrole-t	AMITROL-T	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	G	*	*	E
glyphosate	ROUNDUP	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	E	*	E	*	*	E
glyphosate	ROUNDUP	spot treat or after harvest	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	E	P	E	F	E	E	E	P
amitrole-t and atrazine	AMITROL-T and atrazine[2]	split	E	E	E	E	E	E	E	E	P	F	G	P	P	G	G	P	P	P	P	F	G	P	P	E
atrazine and atrazine	atrazine and atrazine	split	E	E	E	E	E	E	E	E	P	F	E	F	F	E	E	P	F	F	F	G	E	G	G	E

[1] *Split = one preplant or the previous fall and the second applied early post.*

[2] *Various formulations available; see Table 1.*

**Indicates the annual weeds will be controlled if emerged, and the perennials can be controlled if treated at the optimum time which is usually not the same time as for quackgrass.*

Preplant Incorporated

Note: Unless specified, apply all treatments in 150 to 300 L of water per hectare. Two incorporations at right angles using a double disk or vibrating shank cultivator (S-tine type) are reco nmended. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness, and/or treating with incorporation the fields with perennial weeds last.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual grasses	butylate + SUTAN + (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	Use lower rate for light weed infestation or on coarse-textured soils. Butylate + must be applied to a dry soil surface, incorporation may be delayed up to four hours.
	EPTC + ERADICANE (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	See information on butylate +.
Nutsedge*, germinating annual broadleaf and grass weeds, including crabgrass, fall panicum, and proso millet	butylate +*** SUTAN + (800 g/L) either plus atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP) or plus cyanazine** BLADEX (480 g/L) BLADEX (80 WP) or butylate/atrazine (4:1) SUTAZINE + (720 g/L)	3.4 to 6.8 kg/ha 4.25 to 8.5 L/ha 1.2 to 1.8 kg/ha 2.25 to 3.6 L/ha 1.3 to 2.0 kg/ha 1.8 to 2.75 kg/ha 3.75 to 5.5 L/ha 2.25 to 3.25 kg/ha 4.3 to 8.6 kg/ha 6.0 to 12 L/ha	Use the lower rates for light weed infestations or on sand or loam soils. For annual grass control use butylate + rate range of 3.4 to 4.4 kg/ha. For nutsedge or fall panicum use the higher rate range of 4.4 to 6.8 kg/ha. Any late emerging nutsedge will not likely reduce yields. For velvetleaf control use the higher rates of butylate + plus atrazine. To improve overall weed control, atrazine or cyanazine should be used as a tank-mix. Use the low rate of cyanazine on coarse-textured soils, particularly for sweet corn. Mid-season to late season germinating fall panicum may not be controlled by butylate +.
	EPTC + ERADICANE (800 g/L) plus atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP)	3.40 to 6.80 kg/ha 4.25 to 8.5 L/ha 1.2 to 1.80 kg/ha 2.4 to 3.6 L/ha 1.3 to 2.0 kg/ha	See above for information on EPTC +. Proso millet has been observed in Huron, Ontario, Perth, Waterloo and Wellington counties and scattered areas throughout eastern Ontario. For suppression of moderate to heavy infestations of wild proso millet, use the higher rate of EPTC + with atrazine. For most effective suppression of proso millet delay treatment and planting until mid- to late May. Cultivation or a directed post-application of linuron may be required to control later emerging proso millet.
	metolachlor DUAL (960 g/L) plus atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP) or metolachlor/atrazine (1.5:1) PRIMEXTRA (500 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.1 to 1.75 kg/ha 2.25 to 3.75 L/ha 1.2 to 1.94 kg/ha 3.25 to 4.25 kg/ha 6.5 to 8.5 L/ha	Metolachlor controls grasses and atrazine controls the broadleaf weeds. When incorporated, metolachlor will control nutsedge for most of the season (10-14 weeks); mid-season (July) germinating fall panicum may not be controlled. The high rate should be used where annual grass buildup or nutsedge infestation is evident.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Nutsedge*, germinating annual broadleaf and grass weeds, including crabgrass, fall panicum, and proso millet	metolachlor DUAL (960 g/L) plus cyanazine** BLADEX (480 g/L) BLADEX (80 WP)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.75 to 2.75 kg/ha 3.75 to 5.5 L/ha 2.25 to 3.25 kg/ha	Metolachlor controls the grasses and cyanazine controls the broadleaf weeds. Use the high rates of cyanazine for heavy weed infestations or on fine-textured soils. This treatment will give fair control of proso millet. See above treatment for additional notes.
Nutsedge*, germinating annual grasses including crabgrass and fall panicum	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	Metolachlor controls mainly grasses. See above for additional notes.
Germinating annual broadleaf weeds and grasses. Crabgrass and fall panicum may escape	atrazine/simazine (1:1) EKKO (80 WP)	3.4 kg/ha 4.25 kg/ha	Full season annual weed control can be expected except for crabgrass or fall panicum where infestations have built up. Simazine is more persistent than atrazine, thus residues may be high and only corn should be planted the following year.
	simazine SIMADEX (500 g/L) SIMADEX (80 WP)	1.6 to 4.0 kg/ha 3.2 to 8.0 L/ha 2.0 to 2.75 kg/ha	See comments for atrazine/simazine above.
	cyanazine** BLADEX (480 g/L) BLADEX (80 WP) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) or cyanazine/atrazine (2:1) BLAZINE (480 g/L) BLAZINE (80 WP)	2.12 to 2.68 kg/ha 4.4 to 5.5 L/ha 2.65 to 3.35 kg/ha 1.1 to 1.3 kg/ha 2.25 to 2.6 L/ha 1.2 to 1.5 kg/ha 3.25 to 4 kg/ha 6.7 to 8.3 L/ha 4.0 to 5.0 kg/ha	This combination will improve barnyard grass and pigweed control over cyanazine alone. Use the lower rate of both cyanazine and atrazine on coarse-textured soils and the higher rates on medium to fine-textured soils. Do not use on muck or peat soils. Mid-season (July) germinating fall panicum may not be controlled.
Nutsedge* and germinating annual weeds	atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP) followed by atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP)	2.25 kg/ha 4.5 L/ha 2.50 kg/ha 2.25 kg/ha 4.5 L/ha 2.50 kg/ha	Applied in a split-application with the first treatment incorporated with equipment operating at a depth of 10 to 15 cm in the spring before shoots emerge. The second application to be made postemergence in an oil-water emulsion when the nutsedge is 15 cm high. Cultivation may be necessary for good nutsedge control. This total amount of atrazine will control germinating annuals but corn should follow corn because of possible residues.

*Nutsedge is impossible to eradicate in a single season, because of dormant underground tubers. One-season control can be obtained and competition eliminated by using butylate +, EPTC +, metolachlor or the split application of atrazine. Such methods should be used every year where nutsedge is a serious problem (see notes on atrazine residues).

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. (See Table 1.)

***An antidote (safening agent) has been added to both butylate + and EPTC + to prevent corn injury.

Dry bulk fertilizers may be impregnated or coated with various herbicides. Check the label for recommended fertilizer ingredients. This service must be supplied by a fertilizer blender and accurate application of the fertilizer is necessary.

TABLE 3B. CORN HERBICIDE WEED CONTROL RATINGS (PREPLANT INCORPORATED APPLICATIONS)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method[1] of Application	ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
			buckwheat, wild	corn spurry	lady's-thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweeds	triazine resistant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
atrazine/simazine	EKKO	ppi	E	E	E	E	E	E	E	E	P	F	E	E	F	E	E	P	P	P	P	F	F	P	P	E
butylate +	SUTAN +	ppi	P	G	P	F	P	G	F	F	P	P	E	E	G	E	E	F	P	P	P	G	P	P	P	E
butylate + plus atrazine; butylate + /atrazine	SUTAN + plus atrazine; SUTAZINE +	ppi	E	E	E	E	E	E	G	G	P	G	E	E	G	E	E	F	P	P	P	G	F	P	P	E
butylate + plus cyanazine	SUTAN + plus BLADEX	ppi	—	—	—	E	E	E	F	E	P	F	E	E	G	E	E	F	P	P	P	G	P	P	P	E
cyanazine/atrazine	BLAZINE	ppi	E	E	E	E	E	E	E	E	P	F	G	E	G	E	E	P	P	P	P	P	P	P	P	E
EPTC +	ERADICANE	ppi	P	G	F	G	P	G	F	F	P	P	E	E	G	E	E	F	P	F	P	G	P	P	P	E
EPTC + plus atrazine	ERADICANE plus atrazine	ppi	E	E	E	E	E	E	G	G	P	P	E	E	G	E	E	F	P	F	P	G	F	P	P	E

(Continued on Page 66)

TABLE 3B. CORN HERBICIDE WEED CONTROL RATINGS (PREPLANT INCORPORATED APPLICATIONS) (cont'd)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating E — Excellent G — Good F — Fair P — Poor			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
Treatment	**Trade Name**	**Method[1] of Application**	**buckwheat, wild**	**corn spurry**	**lady's-thumb**	**lamb's-quarters**	**mustards**	**nightshades**	**pigweeds**	**ragweeds**	**triazine resistant**	**velvetleaf**	**barnyard grass**	**crabgrass**	**fall panicum**	**foxtails**	**old witch grass**	**proso millet**	**bindweed, field**	**horsetail**	**milkweed**	**nutsedge**	**quackgrass**	**sow-thistle**	**thistle; Canada**	
metolachlor	DUAL	ppi	P	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	G	P	P	P	E
metolachlor + atrazine	DUAL + atrazine; PRIMEXTRA	ppi	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	G	P	P	P	E
metolachlor + cyanazine	DUAL + BLADEX	ppi	E	—	E	E	E	E	G	E	P	F	E	E	G	E	E	P	P	P	P	G	P	P	P	E
simazine	SIMADEX	ppi	E	E	E	E	E	E	E	E	P	F	E	E	F	E	E	P	P	P	P	F	F	P	P	E

[1]*ppi = preplant incorporated.*

Preemergence

Note: Apply all treatments in 150 to 300 L water per hectare except where otherwise noted.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual weeds including crabgrass, fall panicum and triazine-resistant broadleaf weeds	metolachlor DUAL (960 g/L) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 0.6 kg/ha 1.5 L/ha 1.25 L/ha	DO NOT use this tank-mix on sand or sandy loam soil or on sweet corn. High rates should be used on heavy grass infestations and for fall panicum. Fall panicum may not be controlled all season. Dicamba controls velvetleaf, and triazine (atrazine, cyanazine or simazine), resistant broadleaf weeds.

	metolachlor/atrazine (1.5:1) PRIMEXTRA (500 g/L) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	3.25 to 4.25 kg/ha 6.5 to 8.5 L/ha 0.6 kg/ha 1.5 L/ha 1.25 L/ha	See comments for metolachlor plus dicamba above.
Germinating annual grasses including fall panicum and crabgrass	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	Apply along with atrazine, cyanazine, or dicamba for broadleaf control. Fall panicum may not be controlled all season.
Germinating annual weeds including crabgrass and fall panicum	cyanazine* BLADEX (480 g/L) BLADEX (80 WP)	2.25 to 3.25 kg/ha 4.75 to 7.0 L/ha 2.75 to 4.25 kg/ha	Barnyard grass and redroot pigweed may escape. Use the low rate on coarse-textured soils and on sweet corn. Cyanazine is not recommended alone for fine-textured or for muck soils. See other treatments for appropriate tank-mixes.
	cyanazine* BLADEX (480 g/L) BLADEX (80 WP) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) or cyanazine/atrazine (2:1) BLAZINE (480 g/L) BLAZINE (80 WP)	2.25 kg/ha 4.75 L/ha 2.75 kg/ha 1.1 kg/ha 2.25 L/ha 1.2 kg/ha 3.25 kg/ha 7.0 L/ha 4.25 kg/ha	The tank-mix of cyanazine plus atrazine or the formulated mix of cyanazine/atrazine will improve control on fine-textured soils and control of barnyard grass and redroot pigweed. DO NOT use the mixture on muck or peat soils. Fall panicum or velvetleaf may not be controlled for the full season.
	metolachlor DUAL (960 g/L) atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) or metolachlor/atrazine (1.5:1) PRIMEXTRA (500 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.1 to 1.75 kg/ha 2.25 to 3.5 L/ha 1.2 to 1.94 kg/ha 3.25 to 4.25 kg/ha 6.5 to 8.5 L/ha	High rates should be used for heavy grass infestation areas and for fall panicum control. Fall panicum or velvetleaf may not be controlled for the full season.
	metolachlor DUAL (960 g/L) plus cyanazine* BLADEX (480 g/L) BLADEX (80 WP)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.75 to 2.25 kg/ha 3.75 to 4.75 L/ha 2.25 to 2.75 kg/ha	The tank-mix of metolachlor plus cyanazine will control annual grass and broadleaf weeds. Fall panicum may not be controlled for the full season. High rates should be used for heavy grass infestation areas and for fall panicum control, or on fine-textured soils.
Germinating annual broadleaf weeds and some grasses. Crabgrass and fall panicum may escape	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.94 to 2.5 kg/ha	Weeds will normally emerge and die within a few days; atrazine can persist for varying lengths of time; longer under dry, cool weather and coarse-textured soils. See tank-mixes for reducing rates and avoiding residues. Annual grasses, especially crabgrass and fall panicum, are likely to escape.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual broadleaf weeds and some grasses. Crabgrass and fall panicum may escape	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.95 to 2.5 kg/ha 0.6 kg/ha 1.5 L/ha 1.25 L/ha	This treatment should provide good control of triazine-resistant broadleaf weeds and velvetleaf. See notes on atrazine above with respect to residues. DO NOT apply to sand or sandy loam soils or to sweet corn. Some grasses may escape.
	atrazine/simazine (1:1) EKKO (80 WP)	3.4 kg/ha 4.25 kg/ha	Gives full-season annual weed control except for heavy infestations of crabgrass and fall panicum. Soil residues may be high and only corn should be planted the following year.
	simazine SIMADEX (500 g/L) SIMADEX (80 WP)	1.6 to 4.0 kg/ha 3.2 to 8.0 L/ha 2.0 to 2.75 kg/ha	See comments for atrazine/simazine.
Germinating annual broadleaf weeds and some grasses. Crabgrass and fall panicum may escape	cyanazine* BLADEX (480 g/L) BLADEX (80 WP) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	2.25 to 3.25 kg/ha 4.75 to 7.0 L/ha 2.75 to 4.25 kg/ha 0.6 kg/ha 1.5 L/ha 1.25 L/ha	Barnyard grass may not be adequately controlled. Use higher rates on fine soils and heavy weed infestations. DO NOT incorporate this tank-mix or use on sand or sandy loam soils or on sweet corn. Cyanazine and dicamba are short-lived and will disappear before the end of the season, thus fall panicum may not be controlled all season. Dicamba controls velvetleaf, and triazine (atrazine, cyanazine or simazine), resistant broadleaf weeds. See below for additional notes on cyanazine.
	cyanazine/atrazine (2:1) BLAZINE (480 g/L) BLAZINE (80 WP) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	3.25 kg/ha 7.0 L/ha 4.25 kg/ha 0.6 kg/ha 1.5 L/ha 1.25 L/ha	The formulated mix of cyanazine/atrazine will improve control on fine-textured soils and control of barnyard grass and redroot pigweed. See above for use limitations.
	linuron LOROX (480 g/L) LOROX (50 WP) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.1 kg/ha 2.25 L/ha 2.2 kg/ha 1.1 kg/ha 2.2 L/ha 1.2 kg/ha	Use this tank-mix only on clay or clay loam soil to avoid injury. See notes on sweet corn. This tank-mix controls annual weeds and is a method of reducing atrazine residues. Annual grasses will be the first weeds to escape.

**Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

NITROGEN solution can be used as a carrier, instead of water, for preplant and preemergence application of some herbicides. Weed control activity is not increased. Spraying should be done before crop emergence. Consult the herbicide label as to proper methods of application and use of dispersing agents. Calibrate the sprayer to apply the required amount of NITROGEN. Stainless steel flood jet nozzles of adequate size (e.g. Teejet TK SS 5 to TK SS 10) should be used. The NITROGEN solution is mildly corrosive, especially to brass, and the sprayer should be cleaned immediately after use.

UNITE may be used as an aid in improving liquid fertilizer-herbicide compatibility and stability when a simultaneous application of a liquid fertilizer and liquid or wettable powder herbicide is desired. Because formulations and rates vary, it is essential to read the label to determine the exact amount and method to be used. DO NOT apply with postemergence herbicides.

TABLE 3C. CORN HERBICIDE WEED CONTROL RATINGS (PREEMERGENCE APPLICATIONS)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating E — Excellent G — Good F — Fair P — Poor			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
Treatment	**Trade Name**	**Method[1] of Application**	**buckwheat, wild**	**corn spurry**	**lady's-thumb**	**lamb's-quarters**	**mustards**	**nightshades**	**pigweeds**	**ragweeds**	**triazine resistant**	**velvetleaf**	**barnyard grass**	**crabgrass**	**fall panicum**	**foxtails**	**old witch grass**	**proso millet**	**bindweed, field**	**horsetail**	**milkweed**	**nutsedge**	**quackgrass**	**sow-thistle**	**thistle; Canada**	
atrazine	atrazine[2]	pre	E	E	E	E	E	E	E	E	P	F	G	P	P	G	G	P	P	P	P	P	F	P	P	E
atrazine + dicamba	atrazine[2] + BANVEL	pre	E	E	E	E	E	E	E	E	E	G	G	P	P	G	G	P	P	P	P	P	F	P	P	E
atrazine/simazine	EKKO	pre	E	E	E	E	E	E	E	E	P	F	E	F	F	E	E	P	P	P	P	F	F	P	P	E
cyanazine	BLADEX	pre	G	—	G	E	E	E	F	E	P	F	F	E	G	E	E	P	P	P	P	P	P	P	P	E
cyanazine + or/ atrazine	BLADEX + atrazine[2] or BLAZINE	pre	E	E	E	E	E	E	E	E	P	F	G	E	G	E	E	P	P	P	P	P	P	P	P	E
cyanazine + dicamba	BLADEX + BANVEL	pre	G	E	E	E	E	E	E	E	E	G	F	E	G	E	E	P	P	P	P	P	P	P	P	E
cyanazine/atrazine + dicamba	BLAZINE + BANVEL	pre	E	E	E	E	E	E	E	E	E	G	G	E	G	E	E	P	P	P	P	P	P	P	P	E
linuron + atrazine	LOROX + atrazine[2]	pre	E	—	E	E	E	G	E	E	F	F	F	F	F	F	F	P	P	P	P	P	P	P	P	G
metolachlor	DUAL	pre	P	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	P	P	P	P	E
metolachlor + or/ atrazine	DUAL + atrazine[2] or PRIMEXTRA	pre	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	P	P	P	P	E

(Continued on Page 70)

TABLE 3C. CORN HERBICIDE WEED CONTROL RATINGS (PREEMERGENCE APPLICATIONS) (cont'd)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating E — Excellent G — Good F — Fair P — Poor			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
Treatment	**Trade Name**	**Method[1] of Application**	**buckwheat, wild**	**corn spurry**	**lady's-thumb**	**lamb's-quarters**	**mustards**	**nightshades**	**pigweeds**	**ragweeds**	**triazine resistant**	**velvetleaf**	**barnyard grass**	**crabgrass**	**fall panicum**	**foxtails**	**old witch grass**	**proso millet**	**bindweed, field**	**horsetail**	**milkweed**	**nutsedge**	**quackgrass**	**sow-thistle**	**thistle; Canada**	
metolachlor + cyanazine	DUAL + BLADEX	pre	E	—	E	E	E	E	G	E	P	F	E	E	G	E	E	P	P	P	P	P	P	P	P	E
metolachlor + dicamba	DUAL + BANVEL	pre	G	G	E	E	E	E	E	E	E	G	E	E	G	E	E	P	P	P	P	P	P	P	P	E
metolachlor/ atrazine + dicamba	PRIMEXTRA + BANVEL	pre	E	E	E	E	E	E	E	E	E	G	E	E	G	E	E	P	P	P	P	P	P	P	P	E
simazine	SIMADEX	pre	E	E	E	E	E	E	E	E	P	F	E	E	F	E	E	P	P	P	F	F	P	P	E	

[1]*pre = preemergence*
[2]*Various formulations available; see Table 1.*

Postemergence

Note: Apply all treatments in 150 to 300 L water per hectare unless specified otherwise.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Seedling annual broadleaf weeds (5 to 10 cm) and emerging grasses. Crabgrass and fall panicum may escape	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.94 to 2.5 kg/ha	Atrazine applied before the grasses reach the 1-leaf stage will provide good to excellent weed control, broadleaves up to 10 cm in height will be controlled. Under cold and adverse weather conditions, use atrazine alone to avoid crop injury otherwise see atrazine + oil treatment below.

Seedling annual broadleaf weeds (5 to 10 cm) and grasses 1- to 3-leaf stage. Crabgrass and fall panicum may escape	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) plus oil	1.1 to 2.5 kg/ha 2.25 to 5.0 L/ha 1.2 to 2.8 kg/ha	For increased activity and extended period of activity, particularly on annual grasses, apply in an oil-water emulsion of 10 to 17 L of emulsifiable light mineral oil and 150 to 200 L of water per hectare. Available as a formulated mixture such as ATRA-MIX. Apply when most weeds have emerged but when grasses are still in the 1 to 3 leaf stage. The low rate can be used successfully with later cultivation. Heavy infestations of crabgrass and fall panicum may not be controlled.
	atrazine/simazine (1:1) EKKO (80 WP) plus oil	2.6 to 3.4 kg/ha 3.25 to 4.25 kg/ha	Apply in oil-water emulsion. See atrazine above. Simazine is more persistent than atrazine. CORN should be planted again the next year. See notes on atrazine and simazine soil residues.
Emergency quackgrass control	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) plus oil	4.5 kg/ha 9.0 L/ha 5.0 kg/ha	Add 17 L per hectare of an emulsifiable mineral oil to the water and apply to emerged heavy quackgrass stands. This treatment is not as effective as a carefully planned split-application (see preplant section). Severe corn injury may occur, particularly if the corn is under stress or if very cool or hot weather occurs at the time of treatment. Corn must be planted the next year.
Seedling annual weeds including crabgrass and fall panicum; broadleaf weeds (5 to 10 cm); grasses maximum 2-leaf stage	cyanazine BLADEX (80 WP)	2.25 kg/ha 2.75 kg/ha	Use only the wettable powder as the suspension may cause corn burning. DO NOT add oil or surfactants. DO NOT treat corn beyond the 3-leaf stage. Corn injury may occur during cold weather and under flooding conditions.
	cyanazine BLADEX (80 WP) plus atrazine* ATRAZINE (90 WP) or cyanazine/atrazine (2:1) BLAZINE (80 WP)	1.75 to 2.25 kg/ha 2.25 to 2.75 kg/ha 1.1 kg/ha 1.2 kg/ha 2.75 to 3.25 kg/ha 3.25 to 4.25 kg/ha	Use the wettable powder formulation. Excellent control of annual weeds can be obtained if applied before grasses reach the 2-leaf stage. Use the low rate on coarse-textured soils. DO NOT treat corn beyond the 3-leaf stage. Use this triazine mixture where barnyard grass may be a problem. DO NOT add oil or surfactants. Corn injury may occur during cold weather and under flooding conditions.
	metolachlor DUAL (960 g/L) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) or metolachlor/ atrazine (1.5:1) PRIMEXTRA (500 g/L)	1.92 to 2.64 kg/ha 2.0 to 2.75 L/ha 1.1 to 1.75 kg/ha 2.25 to 3.5 L/ha 1.2 to 1.94 kg/ha 3.25 to 4.25 kg/ha 6.5 to 8.5 L/ha	High rates should be used for heavy grass infestation areas and for fall panicum control. Corn should be at the spike to 2 leaf stage. DO NOT add oil or surfactants to this mixture.
Seedling annual weeds and triazine-resistant broadleaf weeds; grasses maximum 2-leaf stage	atrazine ATRAZINE (500 g/L) ATRAZINE (90 WP) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.94 to 2.5 kg/ha 0.28 kg/ha 0.7 L/ha 0.6 L/ha	This treatment will provide good to excellent control of broadleaf weeds including those triazine-resistant and seedling grasses. DO NOT use on sweet corn. See special notes for corn regarding dicamba applications.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Seedling annual weeds and triazine-resistant broadleaf weeds; grasses maximum 2-leaf stage	dicamba/atrazine MARKSMAN (388 g/L)	1.4 to 1.75 kg/ha 3.7 to 4.5 L/ha	Application can be made up to 13 cm standing corn (5 leaf). Use the lower rate on coarse textured soils and the higher rate on medium to fine textured soils. See special notes on postemergence use of dicamba and related hormone chemicals.
Seedling annual weeds including crabgrass, fall panicum and triazine-resistant broadleaf weeds; grasses maximum 2-leaf stage	cyanazine BLADEX (80 WP) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	2.25 kg/ha 2.75 kg/ha 0.28 kg/ha 0.7 L/ha 0.6 L/ha	Use the wettable powder formulation of cyanazine. Excellent control of annual weeds can be obtained if applied before grasses reach the 2-leaf stage. Dicamba will control velvetleaf and triazine-resistant broadleaf annual weeds. DO NOT apply to sweet corn. DO NOT add oil or surfactant. DO NOT treat field corn beyond the 3-leaf stage.
	cyanazine/atrazine (2:1) BLAZINE (80 WP) plus dicamba BANVEL (400 g/L) BANVEL (480 g/L)	2.75 to 3.25 kg/ha 3.25 to 4.25 kg/ha 0.28 kg/ha 0.7 L/ha 0.6 L/ha	Use the wettable powder formulation of cyanazine/atrazine. Excellent control of annual weeds can be obtained if applied before grasses reach the 2-leaf stage. Dicamba will control velvetleaf and triazine-resistant broadleaf annual weeds. DO NOT apply to sweet corn. DO NOT add oil or surfactant. DO NOT treat field corn beyond the 3-leaf stage.
Emerged broadleaf annuals including triazine-resistant strains	bromoxynil* PARDNER (280 g/L) TORCH DS (450 g/L)	0.28 to 0.34 kg/ha 1.0 to 1.2 L/ha .625 to .75 L/ha	Controls most annual broadleaf weeds, including triazine-resistant species at the 1- to 4-leaf stage. Bromoxynil is a contact herbicide and is non-volatile. MANUFACTURERS' LABELS DIFFER, FOLLOW INSTRUCTIONS PRINTED ON THE LABEL.
	MCPA (amine) MCPA (500 g/L)	0.375 to 0.625 kg/ha 0.75 to 1.25 L/ha	Controls triazine-resistant and most other broadleafed weeds. Treat before the corn reaches 15 cm tall (leaf extended). Use the lower rate for small, actively growing weeds and the higher rate for larger weeds or under adverse weather conditions. Top growth of fully developed HORSETAIL (15-25 cm) can be controlled with 1 L/ha of product; a directed late post application using drop nozzles to avoid corn injury is necessary.
Emerged broadleaf annuals, including triazine-resistant strains and wild mustard	bromoxynil/MCPA (1:1) BUCTRIL M (560 g/L)	0.56 kg/ha 1.00 L/ha	Controls most annual broadleaf weeds up to the 4-leaf stage (lamb's-quarters and mustards to 8-leaf stage). Use in preference to bromoxynil when wild mustard is a particular problem. Apply from the 4- to 6-leaf stage of corn but not after the 6-leaf stage.
Emerged broadleaf annuals, including triazine-resistant strains, 1- to 4-leaf stage; grasses 1- to 3-leaf stage. Crabgrass and fall panicum may escape	bromoxynil* PARDNER (280 g/L) bromoxynil TORCH DS (450 g/L) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	0.28 kg/ha 1.0 L/ha .34 kg/ha .75 L/ha plus 1.1 to 2.25 kg/ha 2.25 to 4.5 L/ha 1.2 to 2.5 kg/ha	Controls a wider spectrum of broadleaf weeds than bromoxynil alone; larger velvetleaf will be controlled along with grasses up to the 3-leaf stage. Apply from the 4- to 8-leaf stage of corn. DO NOT add oil or surfactant. DO NOT use formulated atrazine/oil products in this tank mixture. Use the lower rates of atrazine for improving broadleaf weed control and the higher rates for combined broadleaf and grass control.

Emerged broadleaf annuals, including triazine-resistant strains; grasses 1- to 3-leaf stage. Crabgrass and fall panicum may escape	bromoxynil/MCPA (1:1) BUCTRIL M (560 g/L) plus atrazine ATRAZINE (500 g/L) ATRAZINE (90 WP)	0.56 kg/ha 1.00 L/ha 1.1 to 2.25 kg/ha 2.25 to 4.5 L/ha 1.2 to 2.5 kg/ha	Controls a wider spectrum of broadleaf weeds than bromoxynil/MCPA alone; larger velvetleaf will be controlled along with grasses up to the 3-leaf stage. Apply from the 4- to 6-leaf stage of corn but not after the 6-leaf stage. DO NOT add oil or surfactant. DO NOT use formulated atrazine/oil products in this tank mixture. Use the lower rates of atrazine for improving broadleaf weed control and the higher rates for combined broadleaf and grass control.
Emerged annual broadleaf weeds, including triazine-resistant strains; nutsedge, Canada thistle, and suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	Reduce oil concentrate to 1 L/ha of spray solution under hot, humid weather conditions. Apply to corn at the 1- to 5-leaf stage. Control is best when broadleaves are small and actively growing. Grasses are NOT controlled. Top growth of nutsedge and Canada thistle are controlled and field bindweed may be suppressed by 2 applications of 1.75 L/ha (0.84 kg active/ha) applied 10 days apart. Cool weather or drought may delay control.
	bentazon/ atrazine (1:1) LADDOK (400 g/L) plus oil concentrate ASSIST	0.8 to 1.60 kg/ha 2 to 4 L/ha 2 L/ha	The recommended rate of 1.2 to 1.6 kg of bentazon/atrazine (3 to 4 L/ha LADDOK) may be reduced to 0.8 to 1.0 kg/ha (2.0 to 2.5 L/ha LADDOK) if metolachlor has been applied at the recommended rate for preemergence grass control. This treatment will control annual nightshade, redroot pigweed, lamb's-quarters, common ragweed, corn spurry, lady's-thumb, wild mustard and velvetleaf.
Emerged broadleaf annuals, including triazine-resistant strains and some broadleaf perennials	2,4-D* 2,4-D (500 g/L)	0.50 kg/ha 1.0 L/ha	Apply as an overall spray until corn is 15 cm high (leaf extended); thereafter, use drop nozzles. Use amine formulation. See special notes on postemergence use of 2,4-D and related hormone chemicals. DO NOT add oil or surfactant.
Emerged broadleaf annuals, including triazine-resistant strains, Canada thistle, sow-thistle, field bindweed, and wild buckwheat	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.70 kg/ha 2.75 to 4.25 L/ha	Apply when corn is 30 to 60 cm high, using drop pipes. See special notes on postemergence use of MCPB/MCPA and related hormone chemicals. DO NOT add oil or surfactant. Some control of field horsetail may be obtained with the higher rates of MCPB/MCPA.
Emerged broadleaf annuals, including triazine-resistant strains, sow-thistle, wild buckwheat, field bindweed (bloom stage) and Canada thistle (bud stage)	2,4-DB* 2,4-DB (400 g/L) EMBUTOX 625 (625 g/L)	1.1 to 1.50 kg/ha 2.75 to 3.75 L/ha 2.25 to 2.75 L/ha	See remarks for MCPB/MCPA and special notes on postemergence use of 2,4-DB and related hormone chemicals. DO NOT add oil or surfactant. 2,4-DB will not control field horsetail.
Emerged broadleaf annuals, including triazine-resistant strains, sow-thistle, wild buckwheat, and lady's-thumb, Jerusalem artichoke, field bindweed (bloom stage), Canada thistle (bud stage)	dicamba/2,4-D/mecoprop KIL-MOR (485 g/L)	0.41 to 0.53 kg/ha 0.85 to 1.1 L/ha	Apply as an overall spray until corn is 15 cm high (leaf extended); thereafter use drop nozzles. Jerusalem artichoke (30-40 cm in height) can be controlled with 2 sprays (10-14 days apart) per season for two seasons (see specific label instructions). DO NOT add oil or surfactant. See special notes on postemergence use of dicamba and related hormone chemicals.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Emerged broadleaf annuals, including triazine-resistant strains, sow-thistle, wild buckwheat, and lady's-thumb, Jerusalem artichoke, field bindweed (bloom stage), Canada thistle (bud stage)	dicamba BANVEL (400 g/L) BANVEL (480 g/L)	0.28 to 0.6 kg/ha 0.7 to 1.5 L/ha 0.6 to 1.25 L/ha	Application of the lower rate can be made up to 20 cm standing corn. Drop pipes should be used when corn is 20 cm to 50 cm tall. The 0.6 kg/ha rate commonly referred to as the overlay treatment is particularly effective in controlling velvetleaf and providing extended residual control of other late germinating deep-rooted broadleaf annuals and can be applied from the spike stage to the 5-leaf stage (13 cm standing corn). DO NOT use on sweet corn or add oil or surfactant. See special notes on postemergence use of dicamba and related hormone chemicals. DO NOT use dicamba if temperature exceeds 25°C at the time of application, or if high humidity expected, due to the possibility of dicamba volatilizing and injuring susceptible crops nearby. See precautions in SPECIAL NOTES ON CORN.
	dicamba BANVEL (400 g/L) BANVEL (480 g/L) plus 2,4-D* amine 2,4-D (500 g/L)	0.14 kg/ha 0.35 L/ha 0.29 L/ha 0.4 kg/ha acid 0.8 L/ha	Application can be made up to 10 cm, standing corn. Drop pipes should be used when corn is 10 cm to 50 cm tall. DO NOT use on sweet corn, or add oil or surfactant. Use amine formulation of 2,4-D. See special notes on postemergence use of dicamba and 2,4-D and related hormone chemicals. See precautions in SPECIAL NOTES ON CORN.

**Additional formulations are available. See Table 1 and use rates that give comparable amounts of active ingredient.*

Directed Postemergence

Emerged weed vegetation including nutsedge (up to 15 cm high) and horsetail	linuron* AFOLAN F (450 g/L) LOROX (50 WP) plus oil	1.1 to 2.25 kg/ha 2.7 to 5.0 L/ha 2.20 to 4.5 kg/ha	Apply in oil-water emulsion as a directed spray at low pressure with drop nozzles after corn is 30 cm or more in height. The spray must be placed under the corn leaves but on the weeds. Use this treatment as a rescue from weeds escaping a previous treatment. DO NOT apply linuron after corn is beginning to tassel. Follow label directions carefully.

Spot Treatment

Emerged Canada thistle, milkweed and field bindweed	glyphosate	Canada Thistle 1.7 to 2.5 kg/ha milkweed and field bindweed 2.25 to 4.25 kg/ha	DO NOT apply after corn has started to silk. Corn will be killed in the areas sprayed and may be damaged by spray drift in adjacent areas. Knapsack application of 100 mL ROUNDUP in 5 L of water applied to thoroughly wet the foliage, but not to run off, is suggested for small areas to reduce drift and area of corn killed. Apply after field bindweed has reached full flowering, Canada thistle has started flowering or milkweed has reached the bud stage.
	ROUNDUP (356 g/L)	Canada thistle 4.75 to 7.0 L/ha milkweed and field bindweed 7.0 to 12.0 L/ha	

Split Applications

Preplant-incorporated herbicide treatments followed by preemergence or postemergence treatments offer many split applications or sequential combinations or programs. Similarly preemergence treatments may be followed by postemergence herbicides for broad-spectrum weed control. The combination of a herbicide whose strength is killing annual grasses with a herbicide whose strength is mainly broadleaf and/or triazine-resistant weed control is recommended. See recommendations on preceding pages for details about each herbicide.

Herbicides Controlling Most Annual Grasses	Applied	Herbicides Controlling Most Annual Broadleaf Weeds	Applied
butylate + (SUTAN+)	ppi	atrazine*	ppi, pre, post
EPTC + (ERADICANE)	ppi	cyanazine (BLADEX)	ppi, pre, post
metolachlor (DUAL)	ppi, pre, post	simazine*	ppi, pre, post
		dicamba (BANVEL)	pre, post
		linuron*	pre, dir. post
		bentazon (BASAGRAN)	post
		bentazon/atrazine (LADDOK)	post
		bromoxynil*	post
		bromoxynil/MCPA (BUCTRIL M)	post
		2,4-D*	post
		2,4-DB*	post
		MCPA	post
		MCPB/MCPA (TROPOTOX PLUS)	post
		2,4-D/mecoprop/dicamba*	post
		dicamba/atrazine	post

For sequential or split applications use one herbicide from the left-hand column for annual grass control and combine or program it with one of the herbicides from the right-hand column for annual broadleaf weed control. DO NOT TANK-MIX ANY OF THE COMBINATIONS NOT REGISTERED OR RECOMMENDED.

**Additional formulations are available. See Table 1 and use rates that give comparable amounts of active ingredient.*

TABLE 3D. CORN HERBICIDE WEED CONTROL RATINGS (POSTEMERGENCE APPLICATIONS)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method[1] of Application	ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
			buckwheat, wild	corn spurry	lady's-thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweeds	triazine resistant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
atrazine	atrazine[3]	post	E	E	E	E	E	E	E	E	P	F	G	P	P	F	G	P	P	P	P	F	F	F	P	E
atrazine + dicamba	atrazine[3] + BANVEL	post	E	E	E	E	E	E	E	E	E	E	G	P	P	F	G	P	G	P	P	F	F	E	G	E
atrazine + oil	atrazine + oil[3]	post	E	E	E	E	E	E	E	E	P	F	E	P	P	G	G	P	F	F	P	F	F	F	P	G
atrazine/ simazine + oil	EKKO + oil	post	E	E	E	E	E	E	E	E	P	G	E	F	F	E	E	P	P	F	P	F	F	F	F	G
bentazon	BASAGRAN	post	F	—	E	G	E	G	G	E	E	E	P	P	P	P	P	P	G[2]	P	P	G[2]	P	G[2]	G[2]	E
bentazon/atrazine	LADDOK	post	E	E	E	E	E	E	E	E	E	E	G	P	P	F	G	P	F	P	P	G[2]	P	F	F	E
bromoxynil	PARDNER, TORCH DS	post	E	—	E	E	G	E	G	E	E	E	P	P	P	P	P	P	F	P	P	P	P	F	F	E
bromoxynil/ MCPA	BUCTRIL M	post	E	—	E	E	E	E	G	E	E	E	P	P	P	P	P	P	F	F	P	P	P	F	F	G
bromoxynil + atrazine	PARDNER, TORCH DS + atrazine[3]	post	E	E	E	E	E	E	E	E	E	E	G	P	P	G	G	P	F	P	P	P	P	F	F	E
bromoxynil/ MCPA + atrazine	BUCTRIL M + atrazine[3]	post	E	E	E	E	E	E	E	E	E	E	G	P	P	G	G	P	F	F	P	F	F	F	F	G

cyanazine	BLADEX	post	G	—	G	E	E	E	F	E	P	G	F	E	G	E	E	P	P	P	P	P	P	P	G
cyanazine + or/ atrazine	BLADEX + atrazine[3] or BLAZINE	post	E	E	E	E	E	E	E	E	P	G	G	E	G	E	E	P	P	P	P	P	P	P	G
cyanazine + dicamba	BLADEX + BANVEL	post	E	E	E	E	E	E	E	E	E	E	F	E	G	E	E	P	F	P	P	P	P	E	F	G
2,4-D	2,4-D[3]	post	F	P	F	E	E	F	E	E	G	E	P	P	P	P	P	P	F	P	P	P	P	G	G	G
2,4-DB, MCPB/ MCPA	2,4-DB[3], TROPOTOX PLUS	post	G	P	P	F	G	F	E	E	E	E	P	P	P	P	P	P	G	P	P	P	P	G	G	G
dicamba	BANVEL	post	E	E	E	E	F	E	E	E	E	E	P	P	P	P	P	P	G	P	P	P	P	E	G	E
dicamba + 2,4-D	BANVEL + 2,4-D[3]	post	E	E	E	E	E	E	E	E	E	E	P	P	P	P	P	P	G	P	P	P	P	E	G	G
2,4-D/mecoprop/ dicamba	KIL-MOR	post	E	E	E	E	E	E	E	E	E	E	P	P	P	P	P	P	E	P	P	P	P	E	G	G
dicamba/atrazine	MARKSMAN	post	E	E	E	E	E	E	E	E	E	E	F	P	P	F	F	P	G	P	P	P	P	G	G	E
linuron	AFOLAN, LOROX	dir-post	E	E	E	E	E	E	E	E	E	E	E	F	E	G	E	G	F	G	F	G	F	G	F	G
MCPA (amine)	MCPA	post	—	F	P	E	E	—	F	E	E	F	P	P	P	P	P	P	F	G	P	P	P	F	F	G
metolachlor + or/ atrazine	DUAL + atrazine or PRIMEXTRA	post	E	E	E	E	E	E	E	E	P	F	E	E	F	E	E	P	P	P	P	F	F	F	P	E

[1]*post = postemergence; dir-post = directed postemergence.*

[2]*Good control of these perennials may require two applications of bentazon + ASSIST about 7 to 10 days apart.*

[3]*Various formulations available; see Table 1*

SPECIAL NOTES FOR CORN

POSTEMERGENCE WITH 2,4-D, MCPA, MCPB, 2,4-DB, DICAMBA and KIL-MOR

2,4-D, 2,4-DB, MCPB, dicamba, KIL-MOR and some mixtures are needed for control of such weeds as thistles, field bindweed, and triazine-resistant weeds.

Postemergence treatment with 2,4-D can be combined with cultural practices for the control of a wide range of weeds. After the crop is sown, use the rotary hoe, finger weeder, or light harrows to control weed seedlings until the corn is about 5 to 15 cm high (leaf extended). Then apply an overall spray of 2,4-D.

Some varieties of corn become increasingly susceptible to damage from 2,4-D beyond the 15 cm height (leaf extended) but if many broadleaf weeds are present in the rows, spraying is still recommended provided that drop pipes are used on the sprayer to direct the spray to the base of each plant, thus missing the corn leaves.

Do not cultivate until at least 2 weeks after a 2,4-D spray treatment, and then only if necessary. Corn is often brittle for a period of time after spraying and may be damaged by equipment. Cultivation may also damage the shallow feeding roots of corn, as well as bringing ungerminated weed seeds to the ground surface.

Following a period of drought, avoid 2,4-D application for at least a week after a good rain or irrigation.

The recommended 2,4-D treatments will control the top growth and reduce the competition of the more common broadleaved perennial weeds.

2,4-DB and mixtures of MCPB and MCPA (15:1) can be used on corn at higher rates than 2,4-D and therefore will give better control of Canada thistle, sow-thistle, field bindweed and wild buckwheat. These materials should be applied when the corn is 30 to 60 cm high, using drop pipes. Spot treatment is often possible.

Dicamba, dicamba + 2,4-D tank mix or KIL-MOR provide good control of such difficult weeds as field bindweed and Canada thistle. **Drop pipes should be used** when Canada thistle is in the bud stage and field bindweed is at the early flowering stage.

Precautions

DO NOT use 2,4-D, MCPB, 2,4-DB, dicamba, and KIL-MOR later than 2 weeks prior to silking and tasseling. Extreme care must be used when applying these herbicides near susceptible crops because of possible herbicide movement. Soybeans, tomatoes and tobacco are extremely sensitive to dicamba and KIL-MOR and injury symptoms may persist for several weeks. DO NOT use dicamba in the area of susceptible crops when temperatures exceed 25°C on the day of application or if high humidity is expected; due to the possibility of dicamba volatilizing and injuring susceptible crops nearby. Several rows of corn should be left unsprayed when adjacent to soybean fields or other susceptible crops (use precautions on back cover).

TRIAZINE-RESISTANT ANNUAL WEEDS

Strains of lamb's-quarters, pigweed, ragweed and old witchgrass have been found that are resistant to high rates of all TRIAZINE herbicides including atrazine, cyanazine and simazine. These triazine-resistant species have been found in corn-growing areas across Ontario. These strains cannot be visibly distinguished from the susceptible strains. Preemergence treatment with dicamba or postemergence treatment with bentazon, bromoxynil, 2,4-D, dicamba, KIL-MOR or directed linuron will usually give control of the broadleaf species (see appropriate sections above). The grasses can be controlled with butylate*, EPTC*, or metolachlor (see sections above).

NOTES ON ATRAZINE AND SIMAZINE SOIL RESIDUES

Atrazine and simazine residues may last for more than 1 year, particularly if high rates are used more than once and dry weather occurs. If atrazine or simazine is used year after year as in a continuous corn program, triazine residues may be higher. Atrazine when used at rates from 1.2 to 1.8 kg (active) per hectare **(2.4 to 3.6 L of (500 g/L) or 1.2 to 2.0 kg of (90 WP) PRODUCT)** on corn generally has not caused injury on succeeding crops of oats, barley, mixed grains, or soybeans, except in years where there was very little rain the previous fall which would slow down atrazine degradation in the soil. Postemergence treatments may persist longer than preemergence treatments. Variations from this generality of 1.2 to 1.8 kg/ha atrazine may occur across the province.

Injury has been reported on tomatoes, white beans, forage seedings, peas, tobacco, cucumbers, onions, and turnips following applications of atrazine at more than 1.1 kg (active) per hectare **(2.2 L of (500 g/L) or 1.2 kg of (90 WP) PRODUCT)** on corn.

Where crops are to be grown that are extremely sensitive (such as tobacco and vegetable crops) to atrazine, use combinations of butylate* or EPTC* with cyanazine as a preplant incorporated treatment or the combination of metolachlor plus cyanazine as a preemergence treatment.

To reduce the hazard of atrazine residues on succeeding crops:

1. Apply the early postemergence atrazine oil-water treatment with the lower rate of atrazine: 1.1 kg (active) **(2.2 L of (500 g/L) or 1.2 kg of (90 WP) PRODUCT)** per hectare. With this lower rate, a lower measure of weed control may result and cultivations may be necessary.
2. Apply an early postemergence treatment of atrazine using 1.1 kg (active) per hectare **(2.2 of (500 g/L) or 1.2 kg of (90 WP) PRODUCT)** plus 0.55 kg of 2,4-D acid per hectare **(1.1 of 2,4-D AMINE (500 g/L) PRODUCT)**. This may also require one shallow cultivation to control weed escapes. 2,4-D is useful in this mixture where

perennial weeds such as Canada thistle, sowthistle, and curled dock are present.

3. Use the combination of cyanazine, linuron, or metolachlor with atrazine applied preemergence, or EPTC+ or butylate+ with atrazine applied preplant incorporated.
4. Fall plowing will speed TRIAZINE breakdown more than will spring plowing.
5. Mold board plowing will spread triazines to a greater soil depth than chisel plowing thus reducing the concentration of herbicide in the upper soil area.
6. Ensure that the sprayer used is adequate and is properly calibrated and adjusted. Spray uniformly without overlaps and do not spray while the sprayer is stopped.

Atrazine + simazine has an increased soil residue because of the higher rate of triazines used. This mixture should be used only where corn is to follow corn.

If a residue problem is anticipated contact your local Extension Personnel for information on soil analysis procedures for triazine residues.

OIL AND SURFACTANTS WITH ATRAZINE OR ATRAZINE/SIMAZINE MIXTURES

Several blends of OIL* and SURFACTANTS in varying proportions are available for use for postemergence application. The rate of application will vary from 10 to 17 L per hectare for the lowest SURFACTANT content (approx. 1%) to 2.5 to 5 L per hectare for the higher SURFACTANT content (approx. 20%) to 0.5 to 1 L per hectare for undiluted SURFACTANTS.

These materials are sold under various trade names. Follow the label directions closely for best results.

In general, OILS (approx. 1% SURFACTANT) have given best results under adverse conditions. These conditions include use on quackgrass, nutsedge, and heavy infestations of annual grasses or when weeds have developed under dry or cool conditions and are more difficult to control. Instances of early injury on corn have been reported, especially during cold weather, but it may also occur under other conditions of stress such as hot, dry weather. The corn usually has recovered.

The OIL-SURFACTANT mixtures (approx. 20% SURFACTANT) and the undiluted SURFACTANT should be considered where quackgrass, nutsedge or annual grasses are not a serious problem, in an effort to reduce the volume transported when spraying large acreages. Time of application of the oil-surfactant mixtures, or undiluted surfactant, is the same as with OIL-water. Early corn injury seldom occurs with these two materials, but injury may occur if corn is sprayed when more than 25 cm high (leaf extended). Use only commercial mixtures of OIL or SURFACTANTS.

Do not use 2,4-D, MCPA, MCPB, MCPB/MCPA, 2,4-DB, dicamba, KIL-MOR, metolachlor, or cyanazine in conjunction with OIL-WATER emulsions or SURFACTANTS.

WEED CONTROL IN ZERO OR LIMITED TILLAGE CORN

Three typical situations exist:

1. Corn following a meadow crop with no plowing.
2. Corn following corn or stubble crop with no plowing.
3. Corn following corn or stubble crop with primary fall tillage only (e.g. heavy-duty cultivator or double-off-set disk).

For situation 1, any time the previous fall, atrazine may be applied at 4.5 kg (active) per hectare **(9 L of (500 g/L) or 5.0 kg of (90 WP) PRODUCT)**. In the spring, paraquat at 1.1 to 2.2 kg (active) per hectare **(5.5 to 11 L/ha GRAMOXONE (200 g/L))** should be applied along with atrazine at 2.25 to 4.50 kg (active) per hectare **(4.5 to 9.0 L of (500 g/L) or 2.5 to 5.0 kg of (90 WP) PRODUCT)**. The addition of paraquat is necessary under these circumstances, but should not be necessary where atrazine at the 4.5 kg (active) per hectare rate is applied in the fall. The high rate of atrazine 4.5 kg (active) per hectare is necessary in the spring to provide control of orchard grass or bromegrass. With certain perennial weed escapes, including alfalfa, the addition of 2,4-D, KIL-MOR, or dicamba should be considered. Annual grasses should be adequately controlled with metolachlor at 1.92 to 2.64 kg (active) per hectare **(2.0 to 2.75 L per hectare DUAL (960 g/L) PRODUCT)** applied preemergence in the spring. Glyphosate at 1.8 to 2.5 kg/ha active **(5 to 7 L/ha ROUNDUP (356 g/L) PRODUCT)** may be used in the fall or spring for control of emerged annual or perennial weeds. For residual control of annual weeds or subsequent perennial weed growth following the use of glyphosate see recommendations listed under preemergence or postemergence weed control for corn.

In situations 2 and 3 weed control recommendations as listed in the preemergence and postemergence sections should be followed. It must be recognized, however, that when little or no spring tillage has been used, weed emergence and growth patterns may be altered. The practice of zero or limited tillage in corn demands a new approach to weed control; rate of chemical(s) and timing of application must be carefully considered. It should also be understood that a zero tillage corn planter must be used.

**Oil should be a light paraffin-based mineral oil having 70-105 S.U.S. viscosity with over 75% unsulfonatable residues and suitably emulsified.*

PEANUTS

Preplant

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass	glyphosate ROUNDUP (356 g/L)	1.70 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply in fall or spring to actively growing quackgrass with 4 or more leaves per shoot. Fall or spring tillage prior to spring application may reduce control. Wait at least 5 days after application before working the area. Treated quackgrass should be worked down before it turns completely brown for maximum control. Rainfall within 6 hours after application and heavy frosts may reduce control. More than one season control is obtained at these rates.
	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	A reduced rate of Roundup may be used, but only one season-long control can be expected. Apply in the fall or spring previous to the spring crop. Apply in 50 to 100 L water per hectare using flat fan nozzles. Use only in annual cropping systems. Follow other directions above.
	glyphosate ROUNDUP (356 g/L) plus a surfactant plus FRIGATE	0.83 kg/ha 2.34 L/ha plus 0.5 L/100 L spray solution	A reduced rate of Roundup may be used, but only one season-long control can be expected. Apply in the fall or spring previous to the spring crop. Use only in annual cropping systems. Follow other directions above. Use FRIGATE if volume of spray solution is 200 to 300 L/ha.

Preplant Incorporated

Germinating annual grasses, nutsedge and some annual broadleaf weeds	vernolate VERNAM (720 g/L)	2.24 to 2.5 kg/ha 3.1 to 3.45 L/ha	Apply preplant to a dry soil surface and incorporate immediately (within 10 minutes) after application to a 10 cm of depth using a disk (7-10 km/hr) or a vibrating shank cultivator (10-13 km/hr). A second incorporation at right angles is recommended.

Postemergence

Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	1.08 kg/ha 2.25 L/ha plus 2 L/ha	Apply when peanuts are in the unifoliate to 4th trifoliate leaf stage and weeds are small and actively growing. Velvetleaf (15 cm), smartweed (20 cm) and cocklebur (30 cm) tall are controlled. Top growth of nutsedge and Canada thistle is controlled and field bindweed may be suppressed but 2 applications of 1.75 L/ha (0.84 kg active/ha) applied 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Cool weather or drought may delay control. Reduce rate of oil concentrate to 1 L/ha under abnormally hot, humid or cool weather conditions. Otherwise, temporary crop injury may occur.

SOYBEANS

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified. Equipment used to apply DICAMBA (BANVEL), 2,4-D, MCPA, MCPB, MCPB/MCPA, 2,4-DB, KIL-MOR, or related herbicides should be thoroughly cleaned up immediately after use as well as before it is used to spray soybeans. See "Cleaning the Sprayer" section.

Total Weed Control System Although herbicides themselves may be effective, there is benefit in using all the various weed control methods available to obtain the best weed control possible. Crop rotation, herbicide rotation, early weed control with a rotary hoe, harrowing, cultivating, and preventing the spread of weeds as much as possible are all a part of weed management. See the corn section for some details of each of these methods.

Triazine Residues When soybeans follow corn treated with triazines such as atrazine or simazine the previous year, and if triazine residues remain they may interact with a number of herbicides used for weed control in soybeans to cause crop injury. Examples of soybean herbicides which may be involved include the triazine based herbicide metribuzin (Sencor or Lexone) or the substituted urea herbicides (Afolan, Afesin, Lorox or Patoran). The substituted urea herbicides are of less concern in this regard. The potential for injury is greater during adverse weather conditions, in shorter season soybean growing areas and/or in soils with a high pH. Herbicide injury symptoms should not be confused with cold injury symptoms. Also see "Notes on Atrazine and Simazine Soil Residues" which appears near the end of the corn section in this publication.

Triazine Resistant Weeds Biotypes of lamb's-quarters, pigweed and ragweed have been found resistant to all TRIAZINE herbicides including metribuzin (Sencor or Lexone). Resistant strains are difficult to distinguish from triazine susceptible strains. Herbicides effective for the control of triazine resistant weeds in the soybean crop include bentazon, chloramben, linuron, metobromuron and monolinuron. Trifluralin will control triazine resistant lamb's-quarters, pigweed, old witchgrass and green foxtail.

Specific Weeds For information on specific weeds see Table 4. Then refer to the appropriate section for details about herbicide treatments.

Preplant

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass and Canada thistle	amitrole-t AMITROL-T (240 g/L)	3.36 to 4.56 kg/ha 14 to 19 L/ha	Apply to actively growing quackgrass (15-20 cm high) and Canada thistle in the fall or spring. Plow or thoroughly disk 10-14 days after application. Cultivation may be required when the crop is emerged.
Quackgrass	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in fall or spring to actively growing quackgrass with 4 or more leaves per shoot. Fall or spring tillage prior to spring application may reduce control. Wait at least 5 days after application before working the area. Treated quackgrass should be worked down before it turns completely brown for maximum control. Rainfall within 6 hours after application and heavy frosts may reduce control. More than one season control is obtained at these rates.
	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	A reduced rate of Roundup may be used but only one season-long control can be expected. Apply in the fall or spring previous to the spring crop. Apply in 50 to 100 L water per hectare using flat fan nozzles. Use only in annual cropping systems. Follow other directions above.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass	glyphosate ROUNDUP (356 g/L) plus a surfactant plus FRIGATE	0.84 kg/ha 2.35 L/ha plus 0.5 L/100 L spray solution	A reduced rate of Roundup may be used but only one season-long control can be expected. Apply in the fall or spring previous to the spring crop. Use only in annual cropping systems. Follow other directions above. Use FRIGATE if volume of spray solutions is 200 to 300 L/ha.

Preplant Incorporated

Note: Unless specified, apply all treatments in 150 to 300 L of water per hectare. Two incorporations at right angles operating at a depth of 10 cm using a double disk (7-10 km/hour) or vibrating shank S-type cultivator (10-13 km/hour) are required unless otherwise stated. Lower rates are usually for sandy to sandy loam soils, higher rates for clay to clay loam soils.

Germinating annual broadleaf weeds and annual grasses	chloramben AMIBEN (240 g/L) AMIBEN (75 DS)	2.25 to 3.36 kg/ha 9.25 to 14 L/ha 3.0 to 4.5 kg/ha	Amiben may be applied at planting or several days before planting and incorporated into the top 5 to 10 cm of soil. Immediate incorporation is not necessary. In coarse-textured soils, heavy rains may move Amiben below the weed seed germination zone resulting in erratic weed control.
Nutsedge, germinating annual grasses, annual nightshade	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Applied preplant followed by one incorporation with a double disk or vibrating shank (S-tine) cultivator operating at a depth of 10 cm. Lasts 10 to 14 weeks in the soil. Effective on most soils except high organic matter, muck or peat soils.
Germinating annual grasses and some control of lamb's-quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha	Incorporate twice in cross directions using a tandem disc (7-10 km/hr) or vibrating tine cultivator (10-13 km/hr) set to work 8-10 cm deep. The first incorporation should be done as soon as possible after application but may be delayed up to 24 hours. The second incorporation is recommended anytime before planting. See "Notes on Chemicals" section for further details.
Germinating annual grasses, nutsedge	vernolate VERNAM (720 g/L)	2.25 to 3.25 kg/ha 3.1 to 4.5 L/ha	Applied preplant, followed by immediate incorporation (within 10 minutes after application). Ragweed is not controlled. Mustard and ragweed may escape. Lamb's-quarters and pigweed may be controlled. Crop injury may occur which is usually temporary unless adverse weather conditions persist during the growing season.
Germinating annual broadleaf weeds including nightshade and annual grasses and nutsedge	metolachlor DUAL (960 g/L) plus chloramben AMIBEN (240 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.68 to 2.22 kg/ha 7 to 9.25 L/ha	Add Amiben to spray tank first, then add Dual while agitator is running. Incorporate into soil as outlined for Dual. Immediate incorporation is not required.

Germinating annual broadleaf weeds including velvetleaf and annual grasses	metribuzin SENCOR (500 g/L) or LEXONE (75 DF) plus chloramben AMIBEN (240 g/L)	0.28 to 0.75 kg/ha 0.56 to 1.50 L/ha or 0.37 to 1.0 kg/ha plus 1.68 to 2.88 kg/ha 7 to 12 L/ha	Use the higher rate of Amiben on clay soils or where weed pressure is heavier. Do not use on soils with 2% organic matter or less, or on muck soils. Incorporation need not occur immediately. Do not use on varieties Ace, Maple Amber, Nattawa, Baron, Apache or Maple Ridge.
Nutsedge, germinating annual grasses and broadleaf weeds including nightshade, velvetleaf and cocklebur	metolachlor DUAL (960 g/L) plus metribuzin (tank-mix) LEXONE (75 DF) or SENCOR (500 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 0.42 to 0.56 kg/ha 0.54 to 0.64 kg/ha 0.85 to 1.1 L/ha	See metolachlor instructions for incorporation and metribuzin instructions for details. Note: Maximum registered Lexone 75 DF rate is 0.64 kg product/ha (0.48 kg active/ha). Note susceptible varieties above.
Germinating annual grasses and broadleaf weeds including some triazine-resistant annual broadleaf weed species	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L) plus chloramben (tank-mix) AMIBEN (240 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha plus 2.25 to 3.36 kg/ha 9.25 to 14 L/ha	See trifluralin instructions for incorporation and chloramben instructions for necessary details.
Germinating annual grasses and broadleaf weeds, including some triazine-tresistant annual broadleaf weed species	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L) plus metribuzin (tank-mix) LEXONE (75 DF)[1] or SENCOR (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha plus 0.42 to 0.56 kg/ha 0.55 to 0.64 kg/ha 0.85 to 1.1 L/ha	See trifluralin instructions for incorporation and other details and metribuzin instructions for details. This tank-mix, will not control ANNUAL NIGHTSHADE. Do not use on soybean varieties Ace, Maple Amber, Nattawa, Baron, Apache or Maple Ridge. Note: Maximum registered Lexone 75 DF rate is 0.64 kg product/ha (0.48 kg active/ha).

[1]LEXONE (480 g/L) registered rate for this tank-mix is 0.85 to 1.0 L/ha.

Preemergence

Note: Apply all treatments in 150 to 300 L water per hectare. Rainfall at 1.5 to 2 cm/ha within 7 to 10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall. Lower rates are for sandy soils, higher rates for clay or clay-loam soils and rates intermediate to these for loam soils.

Germinating annual broadleaf weeds and annual grasses	chloramben AMIBEN (10% granular) AMIBEN (75 DF)	2.25 to 3.36 kg/ha 23 to 33 kg/ha 3.0 to 4.5 kg/ha	Mustards and cocklebur escape chloramben. Crop safety is excellent. Excessive rainfall may leach out the herbicide. Approximately 6 to 8 weeks control can be expected.
Germinating annual broadleaf, weeds, some annual grasses including some triazine-resistant annual broadleaf weed species	linuron[2] LOROX (480 g/L) AFOLAN F (450 g/L)	1.1 to 2.25 kg/ha 2.5 to 5 L/ha 1.9 to 3.8 L/ha	Annual grasses, ragweed and velvetleaf are partially controlled but are the first to escape, particularly if lower rates of the herbicide are used. Do not use on sands (less than 2% to 3% organic matter, see label.) Seed beans at least 4 cm deep. Heavy rainfall and adverse weather conditions may result in temporary crop injury. Use higher rate for muck soils and clay soils.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual broadleaf weeds, some annual grasses including some triazine-resistant annual broadleaf weed species	metobromuron PATORAN FL (670 g/L)	1.00 to 2.25 kg/ha 2.5 to 3.25 L/ha	See notes for linuron (above) since they apply to metobromuron. Weed control in muck soils requires a 50% increase in the rate of metobromuron to provide acceptable weed control. The lowest rate of Patoran equivalent to 1.0 kg/ha metobromuron will only control certain annual broadleaf weeds and may require inter-row cultivation where possible.
Germinating annual grasses and annual nightshade	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Lasts 10 to 14 weeks in the soil. Effective on a wide range of soil types. Do not use on muck, peat or high organic matter soils. To control broadleaf weeds escaping metolachlor tank-mix with broadleaf weed herbicides (see below).
Germinating annual broadleaf weeds, some grasses and some triazine-resistant annual broadleaf weed species	monolinuron AFESIN (200 g/L)	1.7 to 1.95 kg/ha 8.5 to 9.75 L/ha	Do not use on sandy soils (3% organic matter or less). Beans should be seeded at least 4 cm deep. Annual grasses, ragweed, and velvetleaf are partially controlled but are the first weeds to escape, particularly at lower herbicide rates. Heavy rainfall and adverse weather conditions may result in crop injury, which is usually of a temporary nature.
Germinating annual broadleaf weeds and control grasses including velvetleaf, but not nightshade	metribuzin[3] LEXONE (75 DF) SENCOR (500 g/L)	0.42 to 1.12 kg/ha 0.56 to 1.50 kg/ha 0.85 to 2.25 L/ha	Do not use on sandy soils (2% organic matter or less). Annual nightshade is not controlled. Velvetleaf, cocklebur and Jimsonweed control is usually satisfactory. Barnyard grass is only partially controlled. Use the recommended rate for each soil type (see label), otherwise crop injury may occur. Excessive rainfall and adverse weather conditions may result in crop injury. Do not use on varieties Ace, Maple Amber, Nattawa, Baron, Apache and Maple Ridge.
Germinating annual broadleaf weeds, annual grasses and annual nightshade	metolachlor DUAL (960 g/L) plus chloramben AMIBEN (240 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.68 to 2.22 kg/ha 7.0 to 9.25 L/ha	See metolachlor and chloramben instructions for details.
Germinating annual grasses and annual broadleaf weeds including nightshade and some triazine-resistant annual broadleaf weeds	metolachlor DUAL (960 g/L) plus linuron[6] LOROX (50 WP) AFOLAN (450 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 0.85 to 1.1 kg/ha 1.70 to 2.25 kg/ha 1.90 to 2.50 L/ha	See metolachlor and linuron instructions for details.

	metolachlor DUAL (960 g/L) plus metobromuron PATORAN (400 g/L) or PATORAN (670 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.2 to 1.70 kg/ha 3.0 to 4.25 L/ha or 1.75 to 2.5 L/ha	See metolachlor and metobrumuron for details.
	metolachlor/ metobromuron (3:2) GALEX (500 g/L)	3.12 to 4.25 kg/ha 6.25 to 8.5 L/ha	See metolachlor and metobromuron for details.
Germinating annual grasses and annual broadleaf weeds including nightshade	metolachlor DUAL (960 g/L) plus metribuzin[7] LEXONE (75 DF) or SENCOR (500 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 0.42 to 0.85 kg/ha 0.56 to 0.96 kg/ha 0.85 to 1.7 L/ha	See metolachlor and metribuzin for details. Note: Maximum registered rate for Lexone 75 DF is 0.96 kg product/ha (0.72 kg active/ha).
Germinating annual grasses and annual broadleaf weeds including nightshade and some triazine-resistant annual broadleaf weeds	metolachlor DUAL (960 g/L) plus monolinuron AFESIN (200 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.1 to 1.7 kg/ha 5.5 to 8.5 L/ha	See metolachlor and monolinuron for details.
Germinating annual broadleaf weeds and annual grasses	metribuzin SENCOR (500 g/L) or LEXONE (75 DF) plus chloramben AMIBEN (240 g/L)	0.28 to 0.75 kg/ha 0.56 to 1.50 L/ha or 0.37 to 1.0 kg/ha plus 1.68 to 2.88 kg/ha 7 to 12 L/ha	Use the higher rate of Amiben on clay soils or where weed pressure is heavier. Do not use on soils with 2% organic matter or less or on muck soils or on varieties Ace, Maple Amber, Nattawa, Baron, Apache and Maple Ridge.
Germinating annual grasses and annual broadleaf weeds including some triazine-resistant annual broadleaf weeds	linuron LOROX (50 WP: 480 g/L) AFOLAN (450 g/L) plus chloramben AMIBEN (240 g/L)	0.5 to 1.0 kg/ha 1 to 2 (kg/ha; L/ha) 1.9 to 2.5 L/ha plus 2.22 to 3.36 kg/ha 9.25 to 14 L/ha	Apply at planting time or shortly after planting. Plant crop 3 to 4 cm deep.

SOYBEANS (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual broadleaf weeds and annual grasses including nightshade	metolachlor DUAL (960 g/L) plus metribuzin SENCOR (500 g/L) or LEXONE (75 DF) plus chloramben AMIBEN (240 g/L)	1.12 to 1.8 kg/ha 1.18 to 1.85 L/ha plus 0.28 to 0.75 kg/ha 0.56 to 1.5 L/ha or 0.37 to 1.0 kg/ha plus 1.68 to 2.22 kg/ha 7.0 to 9.25 L/ha	Herbicides should be added to agitating water in tank in the following order: first Sencor or Lexone, then Dual and finally Amiben. Use higher rates for clay to clay loam soils. Do not use on muck soils or on varieties Ace, Maple Amber, Nattawa, Baron, Apache and Maple Ridge.

[2]AFOLAN F (450 g/L) equivalent is 2.45 to 5 L/ha for a 1.1 to 2.25 kg active/ha rate.
[3]LEXONE (480 g/L) equivalent label rate is 1.0 to 2.5 L/ha. SENCOR (50 WP) equivalent rate is 0.85 to 2.25 kg/ha.
[4]LOROX (480 g/L) equivalent rate is 1.8 to 2.25 L/ha.
[5]LEXONE (480 g/L) equivalent rate is 0.9 to 1.6 L/ha. SENCOR (50 WP) equivalent is 0.85 to 1.5 kg/ha.
[6]LOROX (480 g/L) equivalent rate is 1.8 to 2.3 L/ha.
[7]SENCOR (50 WP) equivalent rate is 0.85 to 1.7 kg/ha.

Postemergence

Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	1.1 kg/ha 2.25 L/ha plus 2 L/ha	Apply when soybeans are in unifoliate to 4th trifoliate leaf stage and weeds are small and actively growing. Many annual broadleaf weeds including velvetleaf (15 cm), smartweed (20 cm) and cocklebur (30 cm tall) are controlled. Top growth of Canada thistle and yellow nutsedge is controlled and field bindweed may be suppressed but 2 applications of 1.75 L/ha Basagran (0.84 kg active/ha) 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Temporary crop injury may occur under abnormally cool or hot humid conditions. Reduce rate of oil concentrate to 1 L/ha when those conditions occur. Cool weather or drought may delay control.
Emerged annual grasses including green and yellow foxtail, barnyard grass, old witchgrass, fall panicum, wild oats, and volunteer corn but not crabgrass	diclofop-methyl HOE-GRASS 284 g/L)	1.0 kg/ha 3.5 L/ha	Apply when annual grasses are in the 1- to 4-leaf stage (2- to 3-leaf stage is optimum). Do not mix with other postemergence herbicides because diclofop-methyl is inactivated. Other postemergence herbicides must be applied at least 4 days before or after diclofop-methyl application.

Emerged velvetleaf and smartweed	chloramben AMIBEN (240 g/L) AMIBEN (75 DS)	2.67 to 3.25 kg/ha 11.5 to 14.0 L/ha 3.56 to 4.33 kg/ha	Apply when soybeans are at the cracking to second trifoliate leaf stage. Use high rate on fine-textured soils or when heavy weed infestations are encountered. Velvetleaf and smartweed are controlled or suppressed when chloramben is applied when weeds are 2 to 10 cm tall. Chloramben will also control most annual weeds preemergently. Best control may be achieved by removing emerged weeds by cultivation. If a preplant incorporated or preemergence application of chloramben has already been made, do not re-treat postemergence. Do not feed straw or green fodder treated postemergence with chloramben.
Emerged annual grasses, wild proso millet, wild oats, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate) ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha	Soybeans are tolerant to Poast at any stage of growth. Apply Poast to emerged grasses in the 1- to 6-leaf stage during active growth while crop is small enough to permit thorough spray coverage. Complete control is normally obtained 7 to 21 days after application. A second application may be necessary to control grasses that emerge after the first treatment. Water rates of 50 to 200 L/ha provide the best results.
Quackgrass and annual grasses	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.8 kg/ha 4.4 L/ha 4 L/ha	Thorough preplant tillage will result in more uniform quackgrass emergence. Apply at 1 to 3 leaf stage of actively growing quackgrass in 110 to 200 L water per hectare. Crop competition and inter-row cultivation 7 to 14 days after application will ensure quackgrass control for 6 to 8 weeks.
	sethoxydim POAST (184 g/L) plus Ammonium sulphate (technical grade) or BASF LIQUID Ammonium Sulphate plus oil concentrate ASSIST	0.5 kg/ha 2.7 L/ha 2 kg/ha 4 L/ha 2 L/ha	See above remarks.

Harvest-Aid

Harvest-aid to burn off weeds	diquat plus surfactant REGLONE (200 g/L) plus Agral 90	0.42 to 0.55 kg/ha 2 to 2.75 L/ha 1 L per 1000 L spray solution	Apply in 300 L/ha water to burn off weeds when 80 to 90% natural crop leaf defoliation has occurred. Beware of drift to adjacent crops or plants.
	dinoseb POTATO TOP KILLER (300 g/L)	1.65 to 2.25 kg/ha 5.5 to 7.5 L/ha	Apply in 40 to 80 L/ha water for airplane application. For ground application apply in 60 to 120 L water/ha for low volume sprays or in 200 to 300 L/ha water for high volume sprays. Use higher rates and higher volume sprays in cool cloudy weather and for heavy foliage growth. Note: USE ONLY TO FACILITATE HARVESTING SEED BEANS. Do not feed straw or seed from treated beans to livestock.

Spot Treatment

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Spot treatment control of emerged Canada thistle and quackgrass	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.5 to 7 L/ha	Apply as a spot treatment when quackgrass has more than 4 leaves per stem and milkweed, bindweed, or thistles are at bud to flower stage. The crop will be killed in the sprayed area. Rainfall should not occur within 6 hours after application or weed control will be reduced. Applications may be made up to pod set but not after seed set.
Spot treatment control of milkweed and field bindweed	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	

Split Application

Preplant incorporated herbicide treatments followed by preemergence or postemergence treatments offer many split applications or sequential combinations or programs. Similarly preemergence treatments may be followed by postemergence herbicides for broad spectrum weed control. The combination of a herbicide whose strength is controlling annual grasses with a herbicide whose strength is mainly broadleaf weed control is recommended. Three-quarters of the full rate to the full rate of each partner is recommended depending on soil type and weed infestation.

Herbicides Controlling Most Annual Grasses	Applied	Herbicides Controlling Most Annual Broadleaf Weeds	Applied
trifluralin (TREFLAN, RIVAL)	ppi	linuron (AFOLAN, LOROX)	pre
metolachlor (DUAL)	ppi or pre	metobromuron (PATORAN)	pre
diclofop-methyl (HOE-GRASS 284)	post	monolinuron (AFESIN)	pre
vernolate (VERNAM)	ppi	chloramben (AMIBEN)	pre, ppi, e. post
sethoxydim (POAST)	post	metribuzin (LEXONE, SENCOR)	pre, ppi
		bentazon (BASAGRAN)	post

For sequential or split applications use one herbicide from the left-hand column for annual grass control, and combine or program it with one of the herbicides from the right-hand column for annual broadleaf control. Do not tank-mix any of the products or formulations that are not registered in combination.

TABLE 4. SOYBEAN HERBICIDE WEED CONTROL RATINGS

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method[1] of Application	ANNUAL BROADLEAVES									ANNUAL GRASSES					PERENNIALS							CROP TOLERANCE
			buckwheat, wild	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweed	triazine tolerant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
amitrole-t	AMITROL-T	preplant or post harvest	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2	*	*	2	G	2	2	G
glyphosate	ROUNDUP	spot treat or	*	*	*	*	*	*	*	*	*	*	*	*	*	*	E	P	E	F	E	E	E	P
glyphosate	ROUNDUP	after harvest	*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	*	*	F	*	*	G	P
chloramben	AMIBEN	ppi	E	E	E	P	F	E	G	G	F	G	G	F	G	G	P	P	P	P	P	P	P	G
chloramben + metolachlor	AMIBEN + DUAL	ppi	E	E	E	P	G	E	G	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
chloramben + metribuzin	AMIBEN + SENCOR or LEXONE	ppi	E	E	E	E	F	E	E	G	E	G	G	G	G	G	P	P	P	P	P	P	P	G
metolachlor	DUAL	ppi	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	P	P	P	G
trifluralin	TREFLAN, RIVAL	ppi	F	F	G	P	P	G	P	E	P	E	E	E	E	E	P	P	P	P	P	P	P	G
metolachlor + metribuzin	DUAL plus LEXONE or SENCOR	ppi	G	E	E	E	G	E	E	P	E	E	E	G	E	E	P	P	P	G	P	P	P	G
trifluralin + chloramben	TREFLAN or RIVAL + AMIBEN	ppi	E	E	E	P	F	E	G	E	F	E	E	E	E	E	P	P	P	P	P	P	P	G
trifluralin + metribuzin	TREFLAN or RIVAL + SENCOR or LEXONE	ppi	E	E	E	E	P	E	G	E	E	E	E	E	E	E	P	P	P	F	P	P	F	G
vernolate	VERNAM	ppi	F	F	F	P	P	F	F	P	P	G	E	G	E	G	P	F	P	F	P	P	P	G

(Continued on page 90)

TABLE 4. SOYBEAN HERBICIDE WEED CONTROL RATINGS (cont'd)

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method[1] of Application	ANNUAL BROADLEAVES									ANNUAL GRASSES					PERENNIALS							CROP TOLERANCE
			buckwheat, wild	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweed	triazine tolerant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
chloramben	AMIBEN	pre	E	E	E	P	F	E	G	G	F	G	G	F	G	G	P	P	P	P	P	P	P	E
chloramben + linuron	AMIBEN + LOROX or AFOLAN	pre	E	E	E	G	F	E	G	E	F	G	G	F	G	G	P	P	P	P	P	P	P	E
chloramben + metribuzin + metolachor	AMIBEN + (SENCOR or LEXONE) + DUAL	pre	E	E	E	E	G	E	E	G	E	E	E	G	E	E	P	P	P	P	P	P	P	G
linuron	AFOLAN, LOROX	pre	E	E	E	E	G	E	G	E	F	F	F	F	F	F	P	P	P	P	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	G	E	F	F	F	F	F	F	P	P	P	P	P	P	P	G
metobromuron	PATORAN	pre	E	E	E	E	G	E	G	E	F	F	F	F	F	P	P	P	P	P	P	P	P	G
metribuzin	LEXONE, SENCOR	pre	G	E	E	E	P	E	E	P	E	G	G	G	G	G	P	P	P	P	P	P	P	G
metolachlor	DUAL	pre	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	P	P	P	G
metolachlor	DUAL	pre																						
plus one of 5 treatments (tank-mix) below																								
chloramben	AMIBEN	pre	E	E	E	P	G	E	G	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
linuron	AFOLAN, LOROX	pre	E	E	E	E	G	E	G	E	F	E	E	G	E	E	P	P	P	P	P	P	P	G
metobromuron	PATORAN	pre	E	E	E	E	G	E	G	E	F	E	E	G	E	E	P	P	P	P	P	P	P	G
metribuzin	LEXONE, SENCOR	pre	G	E	E	E	G	E	E	P	E	E	E	G	E	E	P	P	P	P	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	G	E	F	E	E	G	E	E	P	P	P	P	P	P	P	G
metolachlor/ metobromuron	GALEX	pre	E	E	E	E	G	E	G	E	F	E	E	G	E	E	P	P	P	P	P	P	P	G
bentazon	BASAGRAN	post	F	E	G	E	F	G	E	E	E	P	P	P	P	P	[1]G	P	P	[1]G	P	[1]G	[1]G	G
diclofop-methyl	HOE-GRASS	post	P	P	P	P	P	P	P	P	P	E	F	E	E	E	P	P	P	P	P	P	P	E
sethoxydim	POAST	post	P	P	P	P	P	P	P	P	P	E	E	E	E	E	P	P	P	P	G	P	P	E

**Indicates that annual weeds will be controlled if emerged, and the perennials can be controlled if treated at the optimum time, which is usually not the same as for quackgrass.*

[1]Good control of these perennial weeds may require two applications of BENTAZON + ASSIST oil concentrate about 7 to 10 days apart.

[2]Optimum growth stages for best control of these weeds will not likely be attained prior to planting soybeans. See further details on label.

BEANS (WHITE, SNAP and KIDNEY)

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified. Some chemicals may also be impregnated on dry bulk fertilizer. Check the label for recommended fertilizer ingredients.

Registered rates for metobromuron differ between manufacturers. For further information on these and other chemicals refer to label recommendations and also the Notes on Chemicals section of this publication.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplant			
Emerged quackgrass and Canada thistle	amitrole-t AMITROL-T (240 g/L)	3.36 to 4.5 kg/ha 14 to 19 L/ha	**Not registered for use on snap beans or kidney beans.**
Quackgrass	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in 200 to 300 L of water per hectare in the previous fall or in the spring before the crop is planted. More than one season control is obtained at these rates.
	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	For season-long control apply in the fall or spring previous to the bean crop. Apply in 50-100 L water per hectare using flat fan nozzles.
	glyphosate ROUNDUP (356 g/L) plus surfactant FRIGATE	0.84 kg/ha 2.35 L/ha plus 0.5 L/100 L water	For season-long control apply in the fall or spring previous to the bean crop. To be used with water volumes of 200 to 300 L/ha.
Preplant Incorporated			
Germinating annual grasses, nutsedge	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	If dry weather has preceded the application of EPTC, delay seeding 7 to 10 days. Temporary injury can occur in the emerging crop. Many annual broadleaf weeds may escape when EPTC is used alone.
Germinating annual grasses, nutsedge, annual nightshades	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Metolachlor must be preplant incorporated before seeding the crop. Perennial weeds other than nutsedge, are not controlled. Many annual broadleaf weeds may escape when metolachlor is used alone.
Germinating annual grasses, lamb's-quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha	The use of chloramben, metobromuron or monolinuron preemergence or the post-emergence application of bentazon will control additional broadleaf weeds.

BEANS (WHITE, SNAP and KIDNEY) (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual broadleaf weeds and annual grasses	trifluralin TREFLAN (545 g/L) plus chloramben AMIBEN (240 g/L)	0.82 to 1.1 kg/ha 1.5 to 2.1 L/ha 2.22 kg/ha 9.25 L/ha	Do not use on muck or highly organic soils. The treatment should be incorporated as soon as possible after application but may be delayed up to 24 hours. The second incorporation is recommended anytime before planting.
	EPTC EPTAM (800 g/L) plus chloramben AMIBEN (240 g/L)	2.0 to 3.0 kg/ha 2.5 to 3.75 L/ha 1.68 to 3.36 kg/ha 7 to 14 L/ha	This tank-mix should be incorporated immediately after application. Prepare the spray mixture by first filling the spray tank 1/2 to 2/3 full of water. With agitator running, slowly add chloramben followed by EPTC. Do not mix the concentrates before adding to water. Fill tank with the remaining required water.
	EPTC EPTAM (800 g/L) plus trifluralin TREFLAN (545 g/L) plus chloramben AMIBEN (240 g/L)	2.0 to 3.0 kg/ha 2.5 to 3.75 L/ha 0.6 to 1.0 kg/ha 1.1 to 1.8 L/ha 1.68 to 3.36 kg/ha 7 to 14 L/ha	This treatment should be incorporated immediately after application. Prepare the spray mixtures by first filling the spray tank 1/2 to 2/3 full of water. With agitator running, slowly add chloramben, followed by EPTC and trifluralin. Do not mix the concentrates before adding to water. Fill tank with the remaining required water.
Preemergence			
Germinating common annual broadleaf weeds and grasses	chloramben AMIBEN (240 g/L) or AMIBEN (75 DS)	2.22 to 3.38 kg/ha 9.25 to 14.0 L/ha 3.0 to 4.5 kg/ha	**Use the lower rate for sandy soil and the higher rate for clay soil.** Chloramben controls most annual broadleaf weeds and grasses with the exception of mustards for at least 8 weeks after application. Delayed maturity of field beans may occur if heavy rainfall follows application of this chemical.
Germinating common annual broadleaf weeds**	metobromuron PATORAN FL (400 g/L) or PATORAN FL (670 g/L)	1.0 to 1.7 kg/ha 2.5 to 4.25 L/ha 1.75 to 2.5 L/ha	Do not exceed 1.17 kg/ha (active) for kidney beans or snap beans. Beans should be seeded at least 5 cm deep. Injury may occur if beans are under stress or from treated soil having been splashed up onto the leaves by a rainstorm. A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash-up as well as help activate the chemical if dry weather follows application. Cultivation may be required with the low rate. Label rates vary between manufacturers.
	monolinuron AFESIN (200 g/L)	1.1 to 1.4 kg/ha 5.5 to 7.0 L/ha	Beans should be seeded at least 5 cm deep. Shallow planted crops may be injured if heavy rains follow application. A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash-up as well as help activate the chemical if dry weather follows application.

***Common annual broadleaf weeds include ragweed, pigweed, lamb's-quarters, and mustards (see exceptions under Remarks).*

Postemergence

Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha plus 2 L/ha	Use 200 to 400 litres of water per hectare. Apply when beans are in unifoliate to 4th trifoliate leaf stage and weeds are small and actively growing. Many annual broadleaf weeds including velvetleaf (15 cm), smartweed (20 cm), and cocklebur (30 cm) are controlled. Two applications of 1.75 L/ha (0.85 kg ai/ha) 10 days apart may be required to control the perennial weeds. Use the 2.25 L/ha (1.1 kg/ha) rate for annual broadleaf weeds.
Emerged quackgrass and emerged annual grasses	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.8 kg/ha 4.4 L/ha plus 2 to 4 L/ha	Not registered for use on snap beans. Thorough preplant tillage will ensure more uniform quackgrass emergence. Follow with a cultivation 7 days after treatment in wide row crops.
Annual grasses including volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha plus 2 L/ha	Use higher rate for volunteer spring cereals. Treat at the 1 to 6 leaf stage of annual grass.
Green and yellow foxtail, barnyard grass, old witchgrass, wild oats, fall panicum and volunteer corn	diclofop-methyl HOE-GRASS 284 (284 g/L)	1.0 kg/ha 3.5 L/ha	Do not apply if rain is expected within one hour after application. Annual broadleaf weeds must be controlled with other herbicides.

Split Application

Germinating annual broadleaf weeds and grasses, nutsedge	EPTC EPTAM (800 g/L) followed by	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	See remarks on EPTC in preplant incorporated section.
	metobromuron PATORAN FL (400 g/L) or PATORAN FL (670 g/L)	1.0 to 1.7 kg/ha 2.5 to 4.24 L/ha 1.75 to 2.0 L/ha	See remarks on metobromuron and monolinuron in the preemergence section.
	or by monolinuron AFESIN (200 g/L)	0.75 to 1.1 kg/ha 3.75 to 5.5 L/ha	
	or by bentazon plus oil concentrate BASAGRAN (480 g/L) plus ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	See remarks on bentazon in the postemergence section.

BEANS (WHITE, SNAP and KIDNEY) (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annual broadleaf weeds and grasses, nutsedge	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L) followed by bentazon plus oil concentrate BASAGRAN (480 g/L) plus ASSIST	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha 0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	See remarks on trifluralin in the preplant incorporated section. See remarks on bentazon in the postemergence section.
Germinating annual broadleaf weeds and grasses	EPTC EPTAM (800 g/L) followed by chloramben AMIBEN (240 g/L)	2.0 to 3.0 kg/ha 2.5 to 3.75 L/ha 1.68 to 3.36 kg/ha 7 to 14 L/ha	See remarks on EPTC in the preplant incorporated section and chloramben in the preemergence section.
Germinating annual broadleaf weeds and grasses, nutsedge, annual nightshade	metolachlor DUAL followed by metobromuron PATORAN FL (400 g/L) or PATORAN FL (670 g/L) or by monolinuron AFESIN (200 g/L) or by chloramben AMIBEN (240 g/L) or by bentazon plus oil concentrate BASAGRAN (480 g/L) plus ASSIST	1.7 to 2.6 kg/ha 1.75 to 2.75 L/ha 1.0 to 1.68 kg/ha 2.5 to 4.24 L/ha 1.75 to 2.0 L/ha 0.75 to 1.1 kg/ha 3.75 to 5.5 L/ha 2.22 to 3.36 kg/ha 9.25 to 14.0 L/ha 0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	See remarks on metolachlor in the preplant incorporated section. See remarks on metobromuron, chloramben and monolinuron in the preemergence section. See remarks on bentazon in the postemergence section.
Germinating annual broadleaf weeds and annual grasses	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L) followed by metobromuron PATORAN FL (400 g/L) or	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha 1.0 to 1.68 kg/ha 2.5 to 4.24 L/ha	See remarks on trifluralin in the preplant incorporated section. Use TREFLAN (545 g/L) at 1.5 to 2.1 L/ha with chloramben. See remarks on metobromuron, chloramben and monolinuron in the preemergence section.

	PATORAN FL (670 g/L) or by monolinuron AFESIN (200 g/L) or by chloramben AMIBEN (240 g/L)	1.75 to 2.0 L/ha 0.75 to 1.1 kg/ha 3.75 to 5.5 L/ha 2.22 kg/ha 9.25 L/ha	
Germinating annual broadleaf weeds, annual grasses, quackgrass	metobromuron PATORAN FL (400 g/L) PATORAN FL (670 g/L) or monolinuron AFESIN (200 g/L) or chloramben AMIBEN (240 g/L) or AMIBEN (75 DS) followed by sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	1.0 to 1.7 kg/ha 2.5 to 4.24 L/ha 1.75 to 2.0 L/ha 0.75 to 1.1 kg/ha 3.75 to 5.5 L/ha 2.22 to 3.36 kg/ha 9.25 to 14.0 L/ha 3.0 to 4.5 kg/ha 0.15 to 0.8 kg/ha 0.8 to 4.4 L/ha 2 to 4 L/ha	See remarks on metobromuron, monolinuron and chloramben in the preemergence section. See remarks on sethoxydim for annual grass and quackgrass rates in the post-emergence section.
	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST followed by sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	1.1 kg/ha 2.25 L/ha plus 2 L/ha 0.15 to 0.8 kg/ha 0.8 to 4.4 kg/ha plus 2 to 4 L/ha	See remarks on bentazon and sethoxydim in the postemergence section. Allow 4 days between application of sethoxydim and bentazon.

Harvest Aid

Harvest-Aid to burn off weeds	diquat REGLONE (200 g/L) plus surfactant AGRAL 90	0.42 to 0.55 kg/ha 2.1 to 2.75 L/ha plus 1 L/1000 L	Diquat should be used to burn off weeds at 0.42 kg (active) per hectare (2.1 L product) where the weed infestation is light to moderate, and at 0.55 kg (active) per hectare (2.75 L product) where weed infestation is moderate to heavy. Use 300 L/ha of water. Spray when 80 to 90% of the leaves have dropped from the bean plants. Add AGRAL 90 (a wetting and spreading agent) at a rate of 1 L/1000 L of spray mixture to provide a more uniform coverage. Weeds should be burned off in a week or less. **The treatment does not mature beans nor does it lower moisture content** of beans. Pulling and combining beans may be done at any time. **Not registered for use on snap beans.**

TABLE 5. WHITE, SNAP OR KIDNEY BEAN HERBICIDE WEED CONTROL RATINGS

The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Weed Rating and Crop Tolerance
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method+ of Application	ANNUAL BROADLEAVES								ANNUAL GRASSES						PERENNIALS							BEAN TOLERANCE
			buckwheat, wild	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweeds	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
amitrole**	AMITROL-T	preplant or post harvest	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	G	E	G	G
glyphosate	ROUNDUP	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	E	*	*	E
EPTC	EPTAM	ppi	F	F	G	P	F	F	F	F	E	E	E	E	E	F	P	F	P	G	F	P	P	E
metolachlor	DUAL	ppi	P	P	P	P	G	P	P	P	E	E	G	E	E	F	P	P	P	G	P	P	P	G
trifluralin	RIVAL, TREFLAN	ppi	P	P	G	P	P	G	P	P	E	E	G	E	E	F	P	P	P	P	P	P	P	E
trifluralin + chloramben	TREFLAN, AMIBEN	ppi	G	E	E	P	F	E	G	F	E	E	G	E	E	F	P	P	P	P	P	P	P	E
EPTC + chloramben	EPTAM, AMIBEN	ppi	E	E	E	F	F	E	E	F	E	E	G	E	E	F	P	P	P	G	P	P	P	E
EPTC + trifluralin + chloramben	EPTAM, TREFLAN, AMIBEN	ppi	E	E	E	F	F	E	E	F	E	E	E	E	E	F	P	P	P	G	P	P	P	E
chloramben	AMIBEN	pre	G	G	G	F	F	E	G	F	G	F	P	F	G	P	P	P	P	P	P	P	P	E
metobromuron	PATORAN	pre	E	E	E	E	G	E	E	F	F	F	F	F	G	P	P	P	P	P	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	E	F	F	F	—	F	G	P	P	P	P	P	P	P	P	G
bentazon	BASAGRAN	post	F	E	G	E	G	G	E	E	P	P	P	P	P	P	[1]G	P	P	[1]G	P	[1]G	[1]G	G
diclofop-methyl	HOE-GRASS 284	post	P	P	P	P	P	P	P	P	E	E	E	E	E	P	P	P	P	P	P	P	P	E
sethyoxydim**	POAST	post	P	P	P	P	P	P	P	P	E	E	E	E	E	E	P	P	P	P	G	P	P	E

+ ppi = preplant incorporated, pre = preemergence, post = postemergence

***Cannot be used effectively to control these weeds in the bean crop, but it may be used to control all weeds after harvest.*

***Amitrole is not registered for use on snap or kidney beans.*

***Sethoxydim (quackgrass rate 0.8 kg/ha) is not registered for use on snap beans.*

[1]Good control of these perennial weeds may require two applications of BENTAZON + ASSIST OIL CONCENTRATE about 7 to 10 days apart.

TOBACCO (FLUE-CURED and BURLEY)

Preplant

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass, Canada thistle and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in 200 to 300 L of water per hectare in the previous fall or in the spring before the crop is planted. More than one season control is obtained at these rates.
	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	For season long control of quackgrass apply in the fall or spring previous to the spring crop. Apply in 50-100 L water per hectare using flat fan nozzle. Use only in annual cropping system (follow other directions above).
Quackgrass, Canada thistle and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L) plus surfactant FRIGATE	0.84 kg/ha 2.35 L/ha 0.5 L/100 L of spray solution	For season long control of quackgrass apply in fall previous to spring crop. Apply in 200 L or more water per hectare.

Preplant Incorporated

Germinating annual weeds and horsetail	pebulate TILLAM (750 g/L)	4.5 to 5.5 kg/ha 6.3 to 7.7 L/ha	Pebulate should be applied to a dry soil surface and incorporated within 10 minutes. Delay transplanting for 4 days after application. Use the low rate on sandy soils and high rate on loamy sands. It can also be applied at the higher rate prior to row fumigation.

Post Transplant

Apply in 150 to 300 L water per hectare.

Germinating annual weeds	diphenamid ENIDE (50 WP)	4.5 kg/ha or 6.5 kg/ha 9.0 to 13.0 kg/ha	APPLY ONLY IN A BAND. The rate of application is based on spraying a 25 cm band over a 1 metre row planting width (thus 1/4 of the field is actually sprayed). This effectively places 1.125 or 1.625 kg/ha diphenamid (2.25 or 3.25 kg/ha ENIDE PRODUCT) on the 25 cm band. Adjustments must be made for wider or narrower rows. The lower rate is to be used on a light tobacco soil and the higher rate on a heavy tobacco soil. For best results application should be made immediately after transplanting. Since diphenamid may persist in the fall and injure a fall planted cereal crop, after harvest the field should be worked at right angles to the tobacco row and when possible also plowed. Registered for flue-cured tobacco only.

HORTICULTURAL CROPS

Many horticultural crops are damaged by some of our common herbicides. Sprayers that have been used for hormone-type (2,4-D etc.) chemicals SHOULD NOT BE USED for applying insecticides, fungicides, or herbicides on susceptible horticultural crops.

The treatments listed in this publication are based on extensive field trials and observations on farms. **Herbicides should not be used in cold frames or greenhouses unless specifically recommended.**

The higher value per hectare of most horticultural crops compared with field crops sometimes justifies the use of more expensive chemicals. Their correct use should result in savings in cultivation, hand weeding, and other costs. Sometimes weeds escape a chemical treatment and cultivation is necessary. Such weeds should be considered an escape when they reach the 3- to 4-leaf stage.

It is difficult to control quackgrass, field bindweed, horsetail and similar perennial weeds in crops such as asparagus, strawberries, raspberries, etc. which occupy the same area for a period of years. Perennial weeds of this type should be eradicated or brought under control before these crops are planted.

The recommendations for some of the horticultural crops, such as snap beans, and sweet corn will be found in the field crops section because they are similar to those for field beans, and field corn. Differences have been noted where necessary.

WEED CONTROL IN GARDENS

Many garden plants can be killed or damaged by the chemicals used to kill weeds. The frequent use of a hoe, or other shallow cultivation, is the most practical method of controlling weeds in gardens. Most annual weeds can be killed with one or two cultivations. Perennial weeds can be killed by any kind of cultivation which removes all top growth at frequent intervals. After the food stored in the roots has been used, the weeds will die.

When it is possible to apply the chemical to one kind of garden plant, without danger of spray or dust drifting on to susceptible garden plants, one of the chemicals recommended in this publication may be used. (Check list above.) Granular formulations can be applied using a jam jar with a perforated top. This "salt shaker" method, after a little practice, is effective and quick. A small compressed air sprayer can be used to apply any liquid or wettable powder which is mixed in water. It is important that the correct amount be applied. One way of ensuring accuracy is to fill the garden sprayer with water to a mark — apply the spray of water to 100 m^2 taking care to apply it as evenly as possible, and then measure the amount of water used. Add the chemical recommended in the publication to this amount of water for each 100 m^2 treated.

As a guide in converting the recommended rate of any chemical to the amount required for a small area, 32 g per 100 m^2 is approximately equal to 3.25 kg per hectare. For liquid measure, 2 level tbsp is approximately 28 mL. One L of spray mixture per 100 m^2 is equal to 100 L per hectare.

The herbicides listed under each crop are available for farm, custom spraying, and industrial use. **The Ontario Pesticides Act restricts the sale of herbicides to the home gardener to those with a domestic label.** These are:

Generic Name	Example of Product
ammonium sulfamate	- Poison-Ivy and Brush Killer, Brush Killer A
amitrole	- Backyard clean-up
amitrole-simazine mixture	- Vegetation Killer, Steril Liquid
chloramben	- Garden Weeder. Ornamental Weeder, Weed Preventer, No-Hoe
chlorthal dimethyl	- Dacthal
dalapon	- Quack Grass Killer
EPTC	- Eptam, Weed Preventer
2,4-D + mecoprop	- Premium Spot Weed Killer
paraquat/diquat mixtures	- Soluble granules
chlorate/borate mixtures	- TOTAL Vegetation Control, Steril Granular
trifluralin	- Fertilizer mixtures, Weed Preventer, Weed-Stop
various crabgrass control chemicals	- Betasan, Dacthal, trifluralin/fertilizer mixtures and Crabgrass Preventer
2,4-D	- Lawn Weed Killer, fertilizer mixtures

VEGETABLE CROPS

Contact Herbicides

These materials kill all aboveground foliage on contact. Contact herbicides can be used in a stale seedbed technique. The seedbed is prepared early to allow a delay of seeding for several weeks. After the weeds have emerged, but before the crop has emerged, paraquat or diquat (3 to 5.5 L (product) in 250 to 1000 L per hectare) is applied. The soil should be disturbed as little as possible after treatment or a new crop of weeds will appear. These herbicides are registered for this use on beans, beets, carrots, cole crops, onions, peas, potatoes, sweet corn, and rutabagas.

Inter-row weeding with a contact herbicide such as paraquat (3 to 5.5 L (product) in 250 to 1000 L per hectare) can be used as a rescue operation where other methods of weed control have failed. The herbicide is directed between the crop rows onto the emerged weeds. Use special low-pressure (7 to 15 kPa) applicators such as dribble bars or vibra jets equipped with shields to prevent wetting the crop. This technique of weeding with paraquat is registered for use in beans, beets, carrots, cole crops, cucumbers, lettuce, onions, potatoes, sweet corn, and tomatoes.

Pre-Planting Treatments

Pre-planting treatments are applied before the crop is sown or planted. Some of these herbicides kill seedlings soon after germination while others also kill weed seeds. Most herbicides used for these treatments must be thoroughly incorporated in the soil by cultivation soon after application. Check the label.

Selective Preemergence Herbicides

These materials prevent emergence of many weed seedlings without reducing crop stand. This type of material should be applied immediately after seeding or at least before emergence of the crop. If these materials are applied after weeds have emerged, kill is usually poor. Best results are obtained with this method of use when conditions for weed-seed germination are good.

Selective Postemergence Herbicides

These chemicals are applied after the crop plants are up, or after the crop has been transplanted. Applied as directed, the weeds can be killed without injury to the crop. The weeds should be small for best results.

Asparagus

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplanting			
Quackgrass, Canada thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS of WEED CONTROL —SITE PREPARATION for rates and remarks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Before Emergence of Direct-Seeded Asparagus			
Germinating annuals	paraquat GRAMOXONE (200 g/L) chloramben AMIBEN (240 g/L)	0.6 to 1.1 kg/ha 3.0 to 5.5 L/ha 2.25 to 3.25 kg/ha 9.45 to 13.65 L/ha	Apply in 300 to 1100 L water per hectare. Spray on emerged weeds before crop emergence. Preemergence to next crop of weeds. **DO NOT USE TANK-MIX.** Direct seeding of asparagus is only practical if weeds can be controlled from the time of seeding until the asparagus plants develop an extensive root system. Paraquat can be used as a "chemical mower" to kill emerged seedling weeds when the first asparagus seedlings are beginning to emerge. Monitor germination progress of asparagus by frequent examination of germinating seeds to note development. Soon after this application, the chloramben premergence treatment should be made to extend the period of weed control. To be effective these must be separate applications.
1st Year Crown-Established			
Germinating	chloramben AMIBEN (240 g/L) AMIBEN (10 Gr) AMIBEN (75 DS)	2.25 to 3.25 kg/ha 9.45 to 13.65 L/ha 22.5 to 32.5 kg/ha 3.0 to 4.3 kg/ha	On seedling asparagus, chloramben should be applied as a preemergence spray, or as a granular application on emerged seedlings. Use 2.25 kg on sandy soils and 3.25 kg on clay soils. Do not use on marketable asparagus as a residue tolerance has not been established.
2nd Year and Established Asparagus			
Germinating annuals	diuron KARMEX (80 WP) linuron LOROX L (480 g/L) AFOLAN F (450 g/L) metribuzin SENCOR (500 g/L) simazine PRINCEP-NINE-T (90 SG)	1.75 to 2.25 kg/ha 2.1 to 2.7 kg/ha 1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 4.0 to 5.0 L/ha 1.10 to 2.25 kg/ha 2.25 to 4.5 L/ha 2.2 kg/ha 2.5 kg/ha	Disk before any shoots appear in the spring on established plantings. This may be followed by one of the following herbicides. Linuron, diuron, metribuzin or simazine should be applied immediately after the spring disking before weeds germinate in established asparagus. A second application may be made after the postharvest disking. **CAUTION:** The lower rates are recommended for lighter soils. Rates are given for overall sprays. Reduce proportionately if only rows are sprayed. Extreme caution is needed if diuron or simazine is used in rotations where susceptible crops are to be grown one year after application. Use simazine only on established plantings of 3 years and older.

Before Spear Emergence or After Last Cutting

	paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3.0 to 5.5 L/ha	Apply in 300 to 1100 L water per hectare. Paraquat should also be applied on weed seedlings before asparagus tips appear or after the last cutting. Do not apply to emerged spears which are to be used for human consumption. It is particularly effective for control of grass. Use the higher volume of water on dense weed growth.
	paraquat/simazine TERRAKLENE (500 g/L)	2.0 to 3.25 kg/ha 4.0 to 6.5 L/ha	The paraquat/simazine formulation can be applied after weed emergence but before crop emergence. A second application may be applied after harvest and a clean cut. These treatments are recommended for established plantings only and must not be used on direct-seeded asparagus or on young plants during the first growing season after planting. Use the lower rate on sandy soils or on soils low (1 to 2%) in organic matter.

During Harvest Immediately After Cutting

Non-grass annuals, some perennials	2,4-D amine	1.10 to 1.75 kg/ha	Apply in 50 to 100 L water per hectare. May be applied early in the season just after a cutting.
Seedling annual grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	2.5 to 5.0 kg/ha 3.25 to 6.5 kg/ha 3.25 to 6.75 kg/ha	Apply in 50 to 100 L water per hectare. Dalapon and 2,4-D may be combined to control both broadleaf and grass weeds. Dalapon may be used once during the growing season. For quackgrass control, apply after the last cutting and before the last disking. For a spot treatment, spray until the leaves are wet.

After Last Cutting

Perennial weeds	amitrole-t AMITROL-T (240 g/L)	4.6 kg/ha 19.0 L/ha	Amitrole may be used as a spot treatment to control small patches of perennial weeds. The application should be made when the weeds are actively growing. Apply with a knapsack or garden sprayer to wet the leaves of the weeds, avoiding the asparagus fern as much as possible. For larger area mow after the last cutting and spray immediately.
	2,4-D amine	1.10 to 1.75 kg/ha	Apply in 50 to 100 L water per hectare. Apply three weeks after the post-cutting disking. Direct spray to avoid wetting asparagus tops.
Quackgrass	dalapon DOWPON M (74 SP)	11.0 to 16.7 kg/ha 22.0 kg/ha	For spot treatments use 1 kg/ha product in 45 L water and apply till foliage is thoroughly wet.
	BASFAPON (74 SP)	15.0 to 22.5 kg/ha	

Control of redroot pigweed is important to reduce the possibility of infestations of the insect *amaranth case bearer*. This weed should also be controlled on the headlands and margins of the field.

BEANS (LIMA)

Note: Use 150 to 300 litres of water per hectare unless stated otherwise.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplant			
Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in 200 to 300 L of water per hectare in the previous fall or in the spring before the crop is planted. More than one-season control is obtained at these rates.
	glyphosate ROUNDUP (356 g/L)	0.9 kg/ha 2.5 L/ha	For season-long control apply in the fall or spring previous to the bean crop. Apply in 50-100 L water per hectare using flat fan nozzles.
	glyphosate ROUNDUP (356 g/L) plus surfactant FRIGATE	0.83 kg/ha 2.34 L/ha plus 0.5 L/100 L of water	For season-long control apply in the fall or spring previous to the bean crop. To be used with water volumes 200 to 300 L/ha.
Preplant Incorporated			
Germinating annual grasses, lamb's-quarters and pigweed including triazine-resistant species.	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L)	0.6 to 0.8 kg/ha 1.1 to 1.5 L/ha 1.2 to 1.6 L/ha	The use of chloramben, metobromuron, or monolinuron preemergence, or the postemergence application of bentazon will control additional broadleaf weeds.
Germinating annual grasses, nutsedge, annual nightshades	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Metolachlor must be preplant incorporated before seeding the crop. Set tillage equipment such as tandem disks or S-tine cultivators to a depth of 10 cm and thoroughly incorporate in one direction. Immediate incorporation is not necessary. This herbicide lasts 10 to 14 weeks in the soil. It is effective over a wide range of soil types but should not be applied to muck, peat muck or high organic matter soils. Perennial weeds other than nutsedge, are not controlled. Metobromuron, chloramben or monolinuron applied preemergence or bentazon postemergence will control annual broadleaf weeds which may escape metolachlor.

Preemergence

Germinating common annual broadleaf weeds including ragweed, lamb's-quarters, pigweed and mustards	metobromuron PATORAN FL (400 g/L) OR PATORAN FL (670 g/L)	1.0 to 1.7 kg/ha 2.50 to 4.24 L/ha 2.0 to 2.5 L/ha	Beans should be seeded at least 5 cm deep. Injury may occur if beans are under stress. Beans in the early stage of growth may also be injured from treated soil having been splashed up onto the leaves by a rainstorm. A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash-up as well as help activate the chemical if dry weather follows application. Inter-row cultivation may be required when the lowest recommended rate is used.
	monolinuron AFESIN (200 g/L)	1.1 to 1.4 kg/ha 5.5 to 7.0 L/ha	
Germinating annual weeds	chloramben AMIBEN (240 g/L) or AMIBEN (75 DS)	2.22 to 3.36 kg/ha 9.25 to 14 L/ha 3.0 to 4.5 kg/ha	Use the lower rate (2.22 kg/ha active) for sandy soil and the higher rate (3.36 kg/ha active) for clay soil. Chloramben controls most annual broadleaf weeds and grasses with the exception of mustards for at least 8 weeks after application. Delayed maturity of lima beans may occur if heavy rainfall follows application of this chemical. If dry weather follows application, a shallow cultivation, harrowing, or rotary hoeing may be used to improve weed control and help in breaking a soil crust without reducing chemical action.

Postemergence

Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	Use 200 to 400 L of water per hectare. For annual broadleaf weeds apply when beans are in unifoliate to 4th trifoliate-leaf stage and weeds are small and actively growing. Many annual broadleaf weeds are controlled including velvetleaf (15 cm), smartweed (20 cm) and cocklebur (30 cm). Two applications (0.85 kg ai/ha) 10 days apart may be required to control the perennial weeds. Use the 2.25 L/ha (1.1 kg/ha) rate for annual broadleaf weeds.
Green and yellow foxtail, barnyard grass, old witchgrass, wild oats, fall panicum, and volunteer corn	diclofop-methyl HOE-GRASS 284 (284 g/L)	1.0 kg/ha 3.5 L/ha	Diclofop-methyl should be applied postemergence to annual grasses and volunteer corn in the 1- to 4-leaf stage (optimum control at the 2- to 3-leaf stage, approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application. Other herbicides should not be tank-mixed with diclofop-methyl. Other postemergence herbicides should be applied 4 days before or after diclofop-methyl application. Annual broadleaf weeds must be controlled with other herbicides.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Split Applications			
Germinating annual broadleaf weeds and grasses	trifluralin	0.6 to 0.8 kg/ha	See remarks on trifluralin under the preplant incorporated section.
	TREFLAN (545 g/L)	1.1 to 1.5 L/ha	
	or RIVAL (500 g/L)	1.2 to 1.6 L/ha	
	followed by metobromuron	1.0 to 1.7 kg/ha	See remarks on metobromuron, chloramben and monolinuron under the preemergence section.
	PATORAN FL (400 g/L)	2.5 to 4.24 L/ha	
	or PATORAN FL (670 g/L)	2.0 to 2.5 L/ha	
	or by monolinuron	0.75 to 1.1 kg/ha	
	AFESIN (200 g/L)	3.75 to 5.5 L/ha	
	or by chloramben	2.22 to 3.36 kg/ha	
	AMIBEN (240 g/L)	9.25 to 14 L/ha	
	or by bentazon	0.85 to 1.1 kg/ha	See remarks on bentazon under the postemergence section.
	plus oil concentrate		
	BASAGRAN (480 g/L)	2.25 L/ha	
	plus ASSIST	2 L/ha	
Germinating annual broadleaf weeds and grasses, nutsedge, annual nightshades	metolachlor	1.68 to 2.64 kg/ha	See remarks on metolachlor under the preplant incorporated section.
	DUAL (960 g/L)	1.75 to 2.75 L/ha	
	followed by metobromuron	1.0 to 1.7 kg/ha	See remarks on metobromuron, chloramben and monolinuron under the preemergence section.
	PATORAN FL (400 g/L)	2.5 to 4.24 L/ha	
	or PATORAN FL (670 g/L)	2.0 to 2.5 L/ha	
	or by monolinuron	0.75 to 1.1 kg/ha	
	AFESIN (200 g/L)	3.75 to 5.5 L/ha	
	or by chloramben	2.22 to 3.36 kg/ha	
	AMIBEN (240 g/L)	9.25 to 14.0 L/ha	
	or by bentazon	0.85 to 1.1 kg/ha	See remarks on bentazon under the postemergence section.
	plus oil concentrate		
	BASAGRAN (480 g/L)	1.75 to 2.25 L/ha	
	plus ASSIST	2 L/ha	

BEETS (RED)

Preplanting

Quackgrass, Canada thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See section under SPECIAL METHODS OF WEED CONTROL — site preparation for details of rates and remarks.

Preplant Incorporated

Germinating grasses	pebulate TILLAM (720 g/L) cycloate RO-NEET (720 g/L)	4.50 to 6.75 kg/ha 6.30 to 9.25 L/ha 3.25 to 4.50 kg/ha 4.75 to 6.25 L/ha	Apply in 150 to 300 L water per hectare. Use on mineral soils only. Pebulate and cycloate should be applied to a dry soil surface before planting and incorporated. Use the lower rate on sandy soils. These treatments are usually not effective on highly organic soils.

Preemergence

Germinating broadleaf weeds	pyrazon PYRAMIN (430 g/L)	3.55 to 4.50 kg/ha 8.2 to 10.1 L/ha	Apply in 150 to 300 L water per hectare. Use only on mineral soils.
Germinating grasses	TCA (NaTA)	5.50 to 6.75 kg/ha	Use only on mineral soils.
Germinating grasses and broadleaf weeds	pyrazon PYRAMIN (430 g/L) plus TCA (NaTA)	3.55 to 4.40 kg/ha 8.2 to 10.1 L/ha plus 5.50 to 6.75 kg/ha	Pyrazon is best applied at planting time as a preemergence banded treatment for the control of most annual broadleaf weeds.

Postemergence

Annual broadleaf weeds	pyrazon PYRAMIN (430 g/L)	3.55 kg/ha 8.2 L/ha	Apply in 250 ml Citowett Plus, or in 17 L emulsifiable light mineral oil and 300 to 400 L water per hectare. Oil should be light paraffin-based oil having 95 to 110 US viscosity with over 90% of unsulfonatable residues and suitably emulsified.

CABBAGE, CAULIFLOWER, BROCCOLI, BRUSSELS SPROUTS

Preplanting

Quackgrass, Canada thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplant Incorporated			
Germinating annual grasses and good control of lamb's-quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 1.6 L/ha	Direct seeded cabbage or cauliflower or transplants of cabbage, cauliflower, broccoli and brussels sprouts. Incorporate after application.
Preemergence			
Germinating grasses and some broadleaf weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.7 to 14.3 kg/ha	Apply in 250 L water per hectare on mineral soils. Apply immediately after seeding or directly over transplants, preemergence to weeds. Chlorthal dimethyl must be applied uniformly to the soil as a spray. This herbicide can be sprayed directly over transplants without injury. If weeds have emerged, cleanly cultivate the soil before application. Rainfall or irrigation (about 1 cm) is necessary for activation.
CARROTS			
Preplanting			
Quackgrass, Canada thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See section under SPECIAL METHODS OF WEED CONTROL — site preparation for details of rates and remarks.
Preplant Incorporated			
Germinating annual grasses and good control of lamb's-quarters and pigweed species	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 1.6 L/ha	Incorporate after application.

Preemergence

Annuals	linuron LOROX (50 WP) AFOLAN F (540 g/L)	0.6 to 1.1 kg/ha 1.25 to 2.25 kg/ha 1.25 to 2.5 L/ha	Apply in 150 to 300 L water per hectare. Linuron, when used as a preemergence treatment should be applied soon after seeding. Use the lower rate on sandy soils. Carrots are very sensitive to this treatment at time of emergence and severe injury can take place if there is a heavy rain, or if the area is irrigated, at this time. When used as a postemergence treatment, apply after carrots are 8 cm high. The carrot leaves will become yellow or light green but they will soon regain their normal green color. Do not use more than 1.1 kg per hectare on sandy soils. Injury may occur when spraying is done during hot, dry weather, or when the crop is under stress. For preemergence plus postemergence treatment use a maximum of 0.8 kg (active) in the second spray.
	prometryne GESAGARD (80 WP)	1.8 to 3.4 kg/ha 2.25 to 4.25 kg/ha	Apply in 150 to 300 L water per hectare. Use the lower rate on sandy soils and the higher rate on muck soils. Prometryne should also be applied soon after seeding. Do not use at or near time of emergence. IT IS NOT REGISTERED FOR POST-EMERGENCE USE.
	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L) followed by linuron LOROX (50 WP) AFOLAN F (450 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 kg/ha 1.2 to 1.6 L/ha 0.6 to 1.1 kg/ha 1.25 to 2.25 kg/ha 1.25 to 2.5 L/ha	A preplanting application of trifluralin on mineral soils can provide control of most weeds, until the carrots have developed to the stage at which the linuron postemergence treatment can be used.
	prometryne GESAGARD (80 WP) followed by linuron LOROX (50 WP) AFOLAN F (450 g/L)	1.8 to 3.4 kg/ha 2.25 to 4.25 kg/ha 0.6 to 1.1 kg/ha 1.25 to 2.25 kg/ha 1.25 to 2.5 L/ha	On muck soils, a combination procedure which has been successful is to use the preemergence prometryne treatment followed by a postemergence linuron treatment as required.

Postemergence

	herbicidal oil	600 to 800 L/ha **(overall spray)** 300 to 400 L/ha **(rows only)** **undiluted**	Apply the selective herbicidal oil as soon as true leaves develop and before roots of carrots are thicker than a pencil. Later treatments may produce an oil flavor. Weeds should be less than 10 cm high. Ragweed, wormwood, and wild carrot are not controlled.
	linuron LOROX (50 WP) AFOLAN (450 g/L)	1.10 to 2.25 kg/ha 2.25 to 4.50 kg/ha 2.0 to 5.0 L/ha	Apply in 150 to 300 L water per hectare after carrots are 8 to 15 cm high, before grasses exceed 5 cm in height and before broadleaf weeds exceed 15 cm. Do not apply when temperature exceeds 32°C as crop injury may result.

CARROTS (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Green and yellow foxtail, barnyard grass, fall panicum, old witchgrass, wild oats and volunteer corn	diclofop-methyl HOE-GRASS 284 (284 g/L)	1.0 kg/ha 3.5 L/ha	Diclofop-methyl should be applied postemergence to annual grasses in the 1- to 4-leaf stage (optimum control at 2- to 3-leaf stage, approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application.

CELERY

Quackgrass, Canada thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See section under SPECIAL METHODS OF WEED CONTROL — site preparation for details of rates and remarks.
Seedling annuals	herbicidal oil	600 to 800 L/ha **(overall spray)** 300 to 400 L/ha **(rows only)** **undiluted**	Herbicidal oil should be used only on outdoor seedbed and only if the soil is moist. Apply as the true leaves develop on the celery and before weeds are 10 cm high.
	linuron AFOLAN F (450 g/L)	0.9 to 2.25 kg/ha 2.0 to 5.0 L/ha	Apply in 150 to 300 L water per hectare in the transplanted crop. Linuron should be applied 8 to 10 days after transplanting. Some yellowing of the leaves may be noticed but this will be temporary.
	prometryne GESAGARD (80 WP)	2.25 kg/ha 2.75 kg/ha	Apply in 150 to 300 L water per hectare in the transplanted crop. Do not use on direct-seeded crop. Prometryne applications should be delayed 8 to 10 days on the transplanted crop until the celery plants are established.

DILL (See Herbicidal Oil under Carrots)

LETTUCE

Germinating annuals	chlorpropham CIPC (480 g/L)	4.50 to 6.75 kg/ha 9.45 to 14.20 L/ha	Apply in 150 to 300 L water per hectare. When overhead irrigation is used at seeding time, delay chlorpropham application until after first irrigation but before crop emergence. Use lower rates in cool wet weather to avoid injury and delay in emergence. Use lower rates in mineral oils.

CUCUMBER

Preplanting

Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS OF WEED CONTROL — site preparation for details of rates and remarks.

Preplant Incorporated

Germinating annual grasses	bensulide PREFAR (480 g/L)	5.75 to 6.75 kg/ha 12.0 to 14.0 L/ha	Preplant incorporated on mineral soils only.
Germinating annual broadleaf weeds and grasses	bensulide PREFAR (480 g/L) followed by naptalam ALANAP (240 g/L)	4.5 to 6.75 kg/ha 9.5 to 14.0 L/ha 2.25 to 4.5 kg/ha 9.5 to 19 L/ha	Bensulide should be applied before planting and incorporated thoroughly into the soil to a depth of 2.5 to 5 cm. Do not use on muck soils. Bensulide and naptalam may also be tank-mixed and applied preplant incorporated. When tank-mixed with naptalam, incorporation should be to a depth of 2.5 cm or less. Use power-driven rotary cultivators or other equipment which will result in satisfactory incorporation. Use the lower rates in light sandy soils.

Preemergence

Germinating annuals	naptalam ALANAP (240 g/L)	2.64 to 7.20 kg/ha 11.0 to 30.0 L/ha	ALANAP may also be applied as a postemergence spray about one month after the preemergence spray when the crop has emerged following a clean cultivation.
	naptalam + dinoseb DYANAP (360 g/L)	5 to 6 kg/ha 14.0 to 16.8 L/ha	DO NOT APPLY AFTER CROP HAS EMERGED.

MUSKMELON, WATERMELON, SQUASH AND PUMPKIN

Preplanting

Quackgrass, and many other weeds	glyphosate ROUNDUP (356 g/L)		See section under SPECIAL METHODS FOR WEED CONTROL — Site Preparation for rates and remarks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preemergence			
Germinating annuals	naptalam ALANAP (240 g/L)	2.64 to 7.20 kg/ha 11.0 to 30.0 L/ha	DO NOT USE ON BUTTERNUT SQUASH; some injury may occur to Table Queen squash. ALANAP may be applied to melons (not squash or pumpkins) as a postemergence spray about one month after the preemergence spray when the crop has emerged, but before the weeds are up.
	chloramben AMIBEN (240 g/L) AMIBEN (75 DS)	2.25 to 3.25 kg/ha 9.45 to 13.65 L/ha 3.0 to 4.5 kg/ha	Apply in 150 to 300 L water per hectare. Use in pumpkin and squash fields only. DO NOT USE chloramben FOR MUSKMELON AND WATERMELON. Apply chloramben immediately after seeding squash or pumpkin to control most annual broadleaf weeds and grasses. Stunting and delayed maturity may result if heavy rainfall follows application. If dry weather continues after applications a light cultivation may be used to improve weed control and remove emerged weeds.
ONIONS			
Quackgrass, Canada Thistle, bindweed and any emerged broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See section under SPECIAL METHODS OF WEED CONTROL — Site Preparation for details of rates and remarks.
Germinating annuals and seedling grasses	allidochlor RANDOX, CDAA (480 g/L) (20% Gr)	3.25 to 6.70 kg/ha 6.82 to 14.00 L/ha 16.25 to 33.50 kg/ha	PERMITS are required from the Ministry of the Environment under the Pesticides Act for the use of RANDOX (allidochlor). Permit applications should be made to the Ministry of the Environment Pesticide Control Field officers (see page 000). Apply in 150 to 300 L water per hectare, or granular. Pre- or postemergence to crops on muck soils only. Allidochlor is effective against many of the annual weeds found in onions, and is particularly useful on muck soils high in organic matter. Granular postemergence treatments should be made either following a cultivation or before the effect of the previous treatment has been lost. For example, 4.5 kg per hectare applied 4 to 6 weeks after the previous treatment can be used. The chemical is irritating to both eyes and skin.

Germinating annuals and seedling grasses	chlorpropham CIPC (480 g/L) CIPC (10% Gr)	4.5 to 9 kg/ha 9.45 to 18.9 L/ha 45 to 90 kg/ha	Apply in 150 to 300 L water per hectare, or granular, on muck soils. Use 4.50 to 6.75 kg (active) on mineral soils. Pre- or directed postemergence. Chlorpropham is most effective when the weed seeds are germinating. Under cool, moist conditions reduction in stand with decrease in yields has occurred. Direct the postemergence spray to avoid onion leaves. Excellent control of purslane may be obtained. Groundsel, lamb's-quarters, and ragweed are somewhat resistant. Do not use this chemical on bunching onions.
	chlorpropham + allidochlor	3.25 kg/ha of each	Apply in 150 to 300 L water per hectare, preemergence. Chlorpropham-allidochlor mixtures are successful when soil moisture and temperature are most suitable for germination of the weed seeds. In seasons when the soil is very dry and warm the chlorpropham may evaporate and weed control will be poor. PERMIT required, see above.
Emerged broadleaf weeds	oxyfluorfen GOAL (192 g/L)	0.12 kg/ha 0.62 L/ha	Apply in 500 L/ha of water at the two fully developed leaf stage of onions. Repeat applications to control late germinating weeds. PERMITS are required from the Ministry of the Environment under the Pesticides Act for the use of GOAL (oxyfluorfen). Permit applications should be made to the Ministry of the Environment Pesticide Control Field Officers.
Germinating grasses and some broadleaf weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.7 to 14.3 kg/ha	Apply in at least 250 L water per hectare, preemergence on mineral soils. Chlorthal dimethyl should be applied as a preemergence treatment as it kills germinating weed seeds only. It is not effective on muck soils.
Green and yellow foxtail, barnyard grass, fall panicum, old witchgrass, wild oats and volunteer corn	diclofop-methyl HOE-GRASS (284 g/L)	1.0 kg/ha 3.5 L/ha	Diclofop-methyl should be applied postemergence to annual grasses in the 1- to 4-leaf stage (optimum control at 2- to 3-leaf stage, approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application.
Annual grasses including volunteer cereals	sethoxydim POAST (184 g/L) plus ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha	Apply in 110 to 200 L/ha water. Use lower rates for control of annual grasses at 1 to 6 leaf stage and higher rates for volunteer cereals. With heavy infestations of volunteer barley use 1.9 L/ha POAST.
Emerged quackgrass and emerged annual grass	sethoxydim POAST (184 g/L) plus ASSIST	0.8 kg/ha 4.4 L/ha 4 L	Apply at the 1 to 3 leaf stage of actively growing quackgrass in 110 to 200 L/ha of spray solution. Thorough preplant tillage will ensure more uniform quackgrass emergence.
			Most experience with the above herbicides has been with the seeded crop. Experience with sets and limited experience with Spanish onions have been satisfactory. On green bunching onions, the granular formulations (applied when the leaves are dry) are recommended to avoid leaf injury.

PARSLEY (See Herbicidal Oil under Carrots, page 00)

PARSNIPS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass, Canada Thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See section under SPECIAL METHODS OF WEED CONTROL — Site Preparation (for details of rates and remarks).
Germinating annuals	chlorpropham CIPC (480 g/L) CIPC (20 Gr)	4.5 to 9.0 kg/ha 9.45 to 18.9 L/ha 22.50 to 45.0 kg/ha	Chlorpropham should be used at the lower rate on mineral soils and at the higher rate on muck. Apply at time of seeding or up till shortly before emergence of crop and weeds.
	linuron AFOLAN F (450 g/L)	1.10 to 2.25 kg/ha 1.4 to 2.7 L/ha	Apply in 150 to 300 L water per hectare at seeding. Linuron, when used as a preemergence treatment, should be applied soon after seeding. Use lower rate on sandy soils. Heavy rains or irrigation at time of emergence may cause injury from chemical. When used postemergent, apply after parsnips are 8 cm high. Do not use more than 1.1 kg (active) on sandy soils. Applications made when the temperature is high may cause injury, especially at the higher rates.
Emerged weeds	herbicidal oil	600 to 800 L/ha **(overall spray)** or 300 to 400 L/ha **(row only) undiluted**	Herbicidal oil should be applied as soon as true leaves develop and before roots of parsnips are thicker than a pencil. Later treatments may produce an oil flavour. Weeds should be less than 10 cm high.
	linuron AFOLAN F (450 g/L)	1.10 to 2.25 kg/ha 2.5 to 5.0 L/ha	Apply in 150 to 300 L water per hectare, after parsnips are 8 to 15 cm high (see note above).

PEAS

Germinating annual grasses and good control of lamb's-quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.6 to 0.8 kg/ha 1.1 to 1.5 L/ha 1.2 to 1.6 L/ha	Incorporate after application.
Germinating weeds	prometryne GESAGARD (80 WP)	1.8 to 2.2 kg/ha 2.25 to 2.75 kg/ha	Apply in 200 to 300 L water per hectare. Preemergence.

Many seedling annual broadleaf weeds	MCPA-sodium salt* or MCPA amine MCPA (500 g/L)	not more than 0.375 kg/ha not more than 0.75 L/ha	Apply in 100 to 200 L water per hectare. Postemergence.
Many seedling annual broadleaf weeds and Canada thistle	MCPB-sodium salt TROPOTOX (400 g/L) or MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha or 1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in 200 L water per hectare. Apply when the peas have 3 to 6 expanded leaves and when the annual weeds are in the seedling stage. MCPB/MCPA gives better control of wild mustard than MCPB alone.
Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus CITOWETT PLUS	1.1 kg/ha 2.25 L/ha plus 0.25 L/100 L of spray	Apply in 200 to 400 L water per hectare postemergence after the peas have 3 pairs of leaves. Top growth of nutsedge and Canada thistle are controlled and field bindweed may be suppressed by 2 applications of 1.75 L/ha (0.84 kg ai/ha); 10 days apart may be required.
Wild oats	triallate AVADEX BW (400 g/L)	1.5 to 1.75 kg/ha 3.75 to 4.37 L/ha	Apply in 150 to 200 L water per hectare, for dry peas only. Preplant-incorporated.
Wild oats, green and yellow foxtail, barnyard grass, old witch grass and volunteer corn	diclofop-methyl HOE-GRASS (190 g/L)	0.7 kg/ha 3.70 L/ha	For optimum weed control apply diclofop-methyl when the majority of the grass weeds are in the 2- to 3-leaf stage. Spray tips angled forward at 45° will give better coverage. Do not apply if rain is expected within one hour after application.
Annual grasses including volunteer cereals	sethoxydim POAST (184 g/L) plus ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha	FOR DRY PEAS ONLY. Apply in 110 to 200 L/ha water. Use lower rates for control of annual grasses at 1 to 6 leaf stage and higher rates for volunteer cereals.
Emerged quackgrass and emerged annual grass	sethoxydim POAST (1[illegible] g/L) plus ASSIST	0.8 kg/ha 4.4 L/ha 4 L	FOR DRY PEAS ONLY. Apply at the 1 to 3 leaf stage of actively growing quackgrass in 110 to 200 L/ha of spray solution. Thorough preplant tillage will ensure more uniform quackgrass emergence.
Emerged Canada thistle and perennial sow-thistle	amitrole-t AMITROL-T (240 g/L)	3.36 to 4.56 kg/ha 14.0 to 19.0 L/ha	Apply after harvest to emerged actively growing weeds. Wait 10 to 14 days after spraying before working the area.

** Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

PEPPERS

Note: All treatments should be applied in 150 to 300 L water per hectare.

Weed control in the pepper crop is acomplished best by combining chemical and cultural methods.

Discussion of cultural methods can be found in the tomato section.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplant			
Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS OF WEED CONTROL — Site preparation (for details of rates and remarks).
Preplant Incorporated			
Germinating annual grasses and some control of lamb's-quarters and pigweed, including triazine-resistant species	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha	Incorporate twice in cross directions using a tandem disc (7-10 km/hr) or vibrating tine cultivator (10-13 km/hr) set to work 8-10 cm deep. The first incorporation should be done as soon as possible after application but may be delayed up to 24 hours. The second incorporation is recommended anytime before planting. See "Notes on Chemicals" section for further details. If shallow cultivation is to be used to control additional broadleaf weeds, cultivation should start when the weeds have reached the 3-4 leaf stage.
After Transplants Established			
Germinating annual grasses and broadleaf weeds	chloramben granular AMIBEN (10 G)	4.5 kg/ha 45 kg/ha	Apply 2 weeks after transplanting after crop is established but preemergence to weeds. Control weed escapes with cultivation. Do not apply chloramben granular to wet pepper foliage. Mustards and cocklebur are not controlled.
Germinating annual grasses and some broadleaf weeds	diphenamid ENIDE (50 WP)	4.50 to 6.75 kg/ha 9.0 to 13.5 kg/ha	Apply soon after transplanting but preemergence to weeds. Diphenamid residues in the soil have caused damage to fall-seeded wheat or rye. Banding the treatment, fall plowing, adequate rainfall and warm temperatures assist in reducing residues.
Germinating annual grasses	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 12 to 14.7 kg/ha	Apply 2 weeks after planting to established transplants but preemergence to weeds. Cultivate to control weed escapes. Not effective on muck soils.

POTATOES

NOTE: A combination of chemical weed control with cultivation provides the best weed management system. Cultivation prior to potato emergence using various kinds of cultivation equipment (light harrows, finger weeders, hillers, etc.) will control the early flush of weeds. Root pruning of the crop should be minimized. If the crop is hilled after application of herbicides, it must be realized that areas of untreated soil will surface and may result in another flush of weeds in these areas.

Preplant

Quackgrass and other weed species	Glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS OF WEED CONTROL — **SITE PREPARATION** (for details of rates and remarks).

Preplant Incorporated

Germinating annual grasses	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	Apply EPTC to a dry soil surface before planting and incorporate immediately. When applied under wet soil conditions weed control is poor.
Germinating annual grasses and broadleaf weeds	EPTC EPTAM (800 g/L) plus metribuzin SENCOR (500 g/L) or LEXONE (75 DF)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha 0.6 to 0.85 kg/ha 1.2 to 1.7 L/ha 0.80 to 1.1 kg/ha	Apply as a tank-mix in 220 to 330 L water per hectare. Do not use on muck soils. Do not use on varieties BELLEISLE, TOBIQUE or on red-skinned varieties.
Nutsedge and germinating annual grasses	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	Do not use Dual on the variety Superior, or on sandy or coarse-textured soils low in organic matter. Do not apply Dual at ground crack or if potatoes have emerged.
Nutsedge	EPTC EPTAM (800 g/L)	4.4 to 6.8 kg/ha 5.5 to 8.5 L/ha	Apply EPTC to a dry soil surface before planting and incorporate immediately. Use high rates for heavy weed infestations.
Quackgrass	dalapon DOWPON (74 SP) or BASFAPON (74 SP)	8.5 kg/ha 11.5 kg/ha	Apply to grass foliage. Wait three days before completing cultivation. May be used on white-skinned varieties or on red varieties where loss of colour is not serious from a market point of view.

POTATOES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Split Applications			
Nutsedge and germinating annuals	metolachlor	1.92 to 2.64 kg/ha	Apply metolachlor and incorporate thoroughly. Use one of the other chemicals pre-emergence to weeds and crop after the first hilling. Metribuzin may be applied preemergence or early postemergence. Do not use metribuzin on muck soils or on the varieties BELLEISLE, TOBIQUE or on red-skinned varieties.
	DUAL (960 g/L)	2 to 2.75 L/ha	
	followed by one of		
	metobromuron	1.17 to 1.68 kg/ha	
	PATORAN FL (670 g/L)[1]	1.75 to 2.5 L/ha	
	PATORAN FL (400 g/L)	2.92 to 4.2 L/ha	
	or linuron	0.88 to 1.12 kg/ha	
	AFOLAN F (450 g/L)	1.9 to 2.5 L/ha	
	LOROX L (480 g/L)[2]	1.83 to 2.3 L/ha	
	or monolinuron	1.1 to 1.7 kg/ha	
	AFESIN (200 g/L)	5.5 to 8.5 L/ha	
	or metribuzin	0.56 to 1.12 kg/ha	
	SENCOR (500 g/L)[3]	1.12 to 2.25 L/ha	
	LEXONE (75 DF)	0.80 to 1.1 kg/ha	
Preemergence or at Emergence			
Germinating annuals	metolachlor	1.92 to 2.64 kg/ha	
	DUAL (960 g/L)	2 to 2.75 L/ha	
	tank-mixed with one of the following		
	metobromuron	1.17 to 1.68 kg/ha	Metolachlor as a tank-mix plus one of the herbicides listed, should be applied before emergence of the crop and weeds after the first hilling. Do not use metribuzin on muck soils or on the varieties BELLEISLE, TOBIQUE, or on red-skinned varieties. Use the lower rates on sandy soil. For more information about linuron see the remarks for linuron below.
	PATORAN FL (670 g/L)[1]	1.75 to 2.5 L/ha	
	PATORAN FL (400 g/L)	2.92 to 4.2 L/ha	
	or monolinuron	1.1 to 1.7 kg/ha	
	AFESIN (200 g/L)	5.5 to 8.5 L/ha	
	or metribuzin	0.56 to 1.12 kg/ha	
	SENCOR (500 g/L)[3]	1.12 to 2.25 L/ha	
	LEXONE (75 DF)	0.75 to 1.2 kg/ha	
	or linuron	.85 to 2.25 kg/ha	
	LOROX L (480 g/L)[2]	1.8 to 2.3 L/ha	
	AFOLAN F (450 g/L)	1.9 to 2.5 L/ha	
	linuron	1.1 to 2.25 kg/ha	Linuron can be applied immediately after hilling but the potato tops must be covered with soil or the potato plants will be injured. Use the lower rate on light sandy soils and the higher rate on muck or clay soils.
	LOROX L (480 g/L)	2.2 to 4.5 L/ha	
	AFOLAN (450 g/L)	2.70 to 5 L/ha	

	metobromuron PATORAN FL (400 g/L) PATORAN FL (670 g/L)	1.0 to 3.4 kg/ha 2.5 to 8.50 L/ha 2.0 to 2.5 L/ha	Metobromuron may be applied immediately after planting or hilling provided the tops are covered with soil during application. Application may be made when weeds are emerged providing they do not exceed 2.5 cm and tops are not exposed. Use the lower rates on light sandy soil and the higher rates on clay and muck soils. PATORAN FL (400 g/L) at the 2.5 L/ha rate may allow certain annual weeds to escape. Inter-row cultivation may be necessary for full season control. Note that the low rate of PATORAN FL (670 g/L) is equivalent to 1.34 kg of metobromuron.
	monolinuron AFESIN (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11.0 L/ha	Monolinuron can be applied immediately after hilling but all the potato tops must be covered with soil or the crop will be injured. Use the lower rate on soils low in organic matter and the higher rate on clay or soils high in organic matter.
	metribuzin SENCOR (500 g/L)[3] LEXONE (75 DF)	0.6 to 1.1 kg/ha 1.1 to 2.25 L/ha 0.64 to 1.5 kg/ha	Apply after hilling before emergence of crop or weeds. DO NOT USE ON MUCK SOILS. Use the lower rate on sandy soil. Do not use on the varieties BELLEISLE, TOBIQUE, or red-skinned varieties.
	metribuzin (repeat application) SENCOR (500 g/L) LEXONE (75 DF)	refer to remarks section	Metribuzin may be applied as pre/post split application provided the maximum total application rate does NOT exceed 1.12 kg active/ha.
	metribuzin SENCOR (500 g/L)[4] plus dalapon DOWPON (74 SP) or BASFAPON (74 SP)	0.6 to 0.85 kg/ha 1.2 to 1.7 L/ha 8.5 kg/ha 11.5 kg/ha	Apply as a TANK-MIX before potatoes emerge. May be used on white varieties of potatoes and on red-skinned varieties where loss of color is not serious from a marketing point of view. See above note.
	prometryne GESAGARD (80 WP)	2.20 to 2.6 kg/ha 2.75 to 3.25 kg/ha Use 3.40 kg/ha on muck soils. (4.25 kg/ha of 80 WP)	Addition of a surfactant or an emulsifiable oil will improve control where annual grasses predominate. Apply on small weeds just before, or at emergence of the crop. Use the lower rate on coarse sandy soils.
Emerged weeds	paraquat GRAMOXONE (200 g/L)	0.6 to 0.85 kg/ha 3 to 4.25 L/ha	Apply in 275 to 550 L water per hectare to emerged weeds. Use on varieties Netted Gem and Cherokee before emergence. Apply on other varieties until 25 to 30% of the crop has emerged but none of the tops should be over 5 to 8 cm in height. Temporary yellowing on the tops will occur. Do not use on emerged potato plants in the evening, under cloudy conditions or when the plants are under moisture stress.

[1]Patoran (50 WP) equivalent is 2.25 to 3.25 kg/ha
[2]Lorox (50 WP) equivalent is 1.75 to 2.25 L/ha.
[3]Lexone (480 g/L) equivalent is 1.2 to 2.3 L/ha.
[4]Lexone (480 g/L) equivalent is 1.2 to 1.8 L/ha.

HORTICULTURAL CROPS

POTATOES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Postemergence			
Annual grasses, wild oats and volunteer corn	diclofop-methyl HOE-GRASS 284 (284 g/L)	1 kg/ha 3.5 L/ha	DO NOT USE IN TANK-MIX WITH OTHER HERBICIDES. Apply when the majority of the grass weeds are in the 2- to 3-leaf stage. Do not apply if rain is expected within an hour of application. Other postemergence herbicides should be applied at least 4 days before or after Hoegrass applications.
Late germinating grasses	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	Incorporate immediately at next to the last or last cultivation. This treatment may be of value if an earlier treatment has failed or if late germinating grasses are a problem.
Emerged annual weeds	metribuzin SENCOR (500 g/L) or LEXONE (75 DF)	0.6 to 1.10 kg/ha 1.1 to 2.25 L/ha 0.7 to 0.96 kg/ha	Apply early postemergence soon after emergence of the crop and before weeds are 4 cm high. Do not use postemergence on red-skinned varieties or on potatoes grown for the early market, or on the variety Shepody. DO NOT USE ON MUCK SOIL as a residue may injure vegetable crops sown the following season.
Postemergence lay-by Annual broadleaf weeds	chloramben AMIBEN 10 G	2.25 to 4.5 kg/ha 22.5 to 45 kg/ha	Clean cultivate soil to remove all growing weeds among the potato vines. Apply Amiben G immediately after cultivation and before any weed seedlings emerge. Use on **white** potato varieties only.
Annual grasses including volunteer cereals	sethoxydim POAST (184 g/L) plus ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha	Use the higher rates for volunteer cereal control and lower rates for control of annual grasses in 110 to 200 L/ha of water at the 1 to 6 leaf stage.
Emerged quackgrass and annual grasses	sethoxydim POAST (184 g/L) plus ASSIST	0.8 kg/ha 4.4 L/ha 4 L/ha	Preplant tillage will ensure more uniform emergence of quackgrass. Apply at the 1 to 3 leaf stage of actively growing quackgrass in 110-200 L/ha of water. Inter-row cultivation 7 to 14 days after application will ensure control of quackgrass for 6 to 8 weeks.
Emerged quackgrass and annual grasses	sethoxydim POAST (184 g/L) plus AMMONIUM SULPHATE (tech-grade) or BASF liquid AMMONIUM SULPHATE (490 g/L) plus ASSIST	0.5 kg/ha 2.7 L/ha 2 kg/ha 4 L/ha 2 L/ha	Note above comments.
POTATO VINE KILLING			For information on products and rates of application for vine killing, refer to the Potato Section of OMAF Publication 363, Vegetable Production Recommendations.

RUTABAGA

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	**REMARKS** (For more information, see "Notes on Chemicals" section.)
Preplant			
Quackgrass and many other weeds	glyphosate ROUNDUP (356 kg/L)		See under "SPECIAL METHODS FOR WEED CONTROL: SITE PREPARATION" for rates and remarks.
Preplant Incorporated			
Germinating annual grasses and some control of lamb's-quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.8 to 1.1 kg/ha 1.5 to 2.1 L/ha 1.6 to 2.3 L/ha	See "Notes on Chemicals" section for details. If shallow cultivation is to be used to control additional broadleaf weeds, cultivation should start when the weeds have reached the 3-4 leaf stage.
Germinating annual grasses, annual nightshades and nutsedge	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2.0 to 2.75 L/ha	Incorporate metolachlor thoroughly.
Preemergence			
Germinating annual grasses and annual nightshades	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2.0 to 2.75 L/ha	Lasts 10-14 weeks in the soil.

SPINACH

Quackgrass, Canada thistle, bindweed and any emerged annual broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)		See section under "SPECIAL METHODS OF WEED: SITE PREPARATION" for details of rates and remarks.
Germinating grasses	cycloate RO-NEET (720 g/L)	3.4 kg/ha 4.75 L/ha	Preplant incorporated in 150 to 300 L water per hectare on mineral soils only. Cycloate should be applied to a dry soil surface before planting, and incorporated within 10 minutes with a double disk. A second incorporation at right angles in tandem with a harrow should follow as soon as possible. Use the lower rate on sandy soils.

SPINACH (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating annuals	chlorpropham CIPC (480 g/L)	1.3 to 5.0 kg/ha 2.73 to 10.0 L/ha	Preemergence in 150 to 300 L water per hectare on mineral soils only. Chlorpropham should be used at higher rates during warm weather between May 1 to October 15 on heavy soils. Use lower rates during cool season between October 15 to May 1 and on sandy loam soils.

TOMATOES

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified.

Weed control in tomatoes usually consists of a combination of chemical weed control and cultivation. Crop rotation is also beneficial in the control of weeds. Cultivation should be shallow to prevent bringing untreated soil to the surface which may result in another flush of weeds. When tomatoes are grown on raised beds and beds are reshaped during the course of the season, it may be necessary or useful to apply another herbicide treatment to areas between the rows to prevent a new weed infestation from interfering with harvesting. Do not exceed the total recommended rate per season of any herbicide applied more than once per year.

Band treatment of herbicides over the row will reduce the cost by one-half to two-thirds depending on the width of the band, compared to the row spacing. Shallow inter-row cultivation will be required for weed control between the rows.

Perennial weeds may be partially controlled by cultivation. Controlling them in crops other than tomatoes when grown in rotation is the best approach to perennial weed control. Perennials are easily spread with cultivators or tillage equipment. Areas of perennial weeds are best tilled last. Machinery sanitation is important when moving from one field to another.

TRANSPLANTED TOMATOES

Preplant

Quackgrass and many other weeds	glyphosate ROUNDUP (356 kg/L)		See under "SPECIAL METHODS FOR WEED CONTROL: SITE PREPARATION" for rates and remarks.

Preplant Incorporated

Germinating annual grasses and some control of broadleaf weeds such as lamb's-quarters and pigweed, including triazine-resistant species	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha	Incorporate twice in cross directions using a tandem disc (7-10 km/hr) or vibrating tine cultivator (10-13 km/hr) set to work 8-10 cm deep. The first incorporation should be done as soon as possible after application but may be delayed up to 24 hours. The second incorporation is recommended anytime before planting. See "Notes on Chemicals" section for further details. Cool, wet weather may cause stunting of tomato transplants but yield is not usually affected.

Germinating annual grasses and annual broadleaf weeds	trifluralin TREFLAN (545 g/L) plus metribuzin SENCOR (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha plus 0.25 to 0.7 kg/ha 0.5 to 1.4 L/ha	Follow incorporation instructions as above for trifluralin. Use only for processing tomatoes. The lower rates are for sandy soils and higher rates for clay soils.
Germinating annual grasses, some annual broadleaf weeds and nutsedge	pebulate TILLAM (720 g/L)	4.50 to 6.70 kg/ha 6.25 to 9.25 L/ha	Apply to a dry soil surface and incorporate immediately (see incorporation instructions for trifluralin above).

After Transplants Established: Preemergence to Weeds

Germinating annual grasses and broadleaf weeds including some nightshade control	chloramben granular AMIBEN (10 G)	4.5 kg/ha 45 kg/ha	Apply 2 weeks after transplanting when tomato plants are established but preemergence to weeds. Control weed escapes with cultivation. Do not apply granular chloramben to wet tomato foliage. Mustards and cocklebur are not controlled. A rainfall or irrigation within 7 to 10 days after application is required to activate the herbicide.
Germinating annual grasses and some broadleaf weeds	diphenamid ENIDE (50 WP)	4.5 to 6.75 kg/ha 9.0 to 13.50 kg/ha	Apply soon after transplanting but preemergence to weeds. Soil residues have caused damage to fall seeded wheat or rye. Banding the treatment, fall plowing, adequate rainfall and higher temperatures will assist in reducing diphenamid residues.

Postemergence

Germinating and emerged annual grasses and broadleaf weeds	metribuzin[1] SENCOR (500 g/L) LEXONE (75 DF)	0.30 to 0.85 kg/ha 0.55 to 1.70 L/ha 0.32 to 1.1 kg/ha	Use in processing tomatoes only. Apply before weeds exceed 5 cm tall. Direct spray to bottom one-third of tomato plants to reduce risk of crop injury. Apply 3 weeks after transplanting when tomato plants are established. Avoid application when crop is under stress due to cool, wet, cloudy weather or excessively hot temperatures. Some tomato varieties are more sensitive than others. Use lower rates on sandy soils, higher rates on clay soils.
Emerged annual grasses, wild proso millet, wild oats, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha	Tomatoes are tolerant to Poast at any stage of growth. Apply Poast to emerged grasses in the 1 to 6 leaf stage during active growth while crop is small enough to permit thorough spray coverage. Complete control is normally obtained 7 to 21 days after application. A second application may be necessary to control grasses that emerge after the first treatment. Water rates of 50 to 200 L/ha provide the best results.
Quackgrass and annual grasses	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.8 kg/ha 4.4 L/ha 4 L/ha	Thorough preplant tillage will result in more uniform quackgrass emergence. Apply at 1 to 3 leaf stage of actively growing quackgrass in 110 to 200 L water per hectare. Crop competition and inter-row cultivation 7 to 14 days after application will ensure quackgrass control for 6 to 8 weeks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplant Incorporated followed by Postemergence			
Germinating and emerged annual grasses and broadleaf weeds	trifluralin TREFLAN (545 g/L) or RIVAL (500 g/L) followed by metribuzin SENCOR (500 g/L) or LEXONE (75 DF)	0.60 to 1.10 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha followed by 0.30 to 0.85 kg/ha 0.55 to 1.7 L/ha 0.32 to 1.1 kg/ha	Preplant incorporate trifluralin. Then follow-up with a postemergence application of metribuzin. See instructions above for both herbicides.
Germinating annual grasses and annual broadleaf weeds	trifluralin TREFLAN (545 g/L) plus metribuzin SENCOR (500 g/L) followed by metribuzin SENCOR (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha plus 0.25 to 0.7 kg/ha 0.5 to 1.4 L/ha followed by 0.425 to 0.7 kg/ha 0.85 to 1.4 L/ha	Follow incorporation instructions for the tank-mix of trifluralin plus metribuzin as outlined above. Apply second application of metribuzin as a directed postemergence application to base of tomato plants, as outlined above for metribuzin applied postemergence. Use only on tomatoes for processing. Do not exceed total recommended rate of metribuzin when two applications are made for the soil type involved (see the label).
Preemergence and Postemergence			
Germinating and emerged annual grasses and broadleaf weeds including some nightshade control	chloramben AMIBEN (10 G) followed by metribuzin[1] SENCOR (500 g/L) or LEXONE (75 DF)	4.5 kg/ha 45 kg/ha followed by 0.30 to 0.85 kg/ha 0.55 to 1.7 L/ha 0.32 to 1.1 kg/ha	Apply chloramben granular to established tomato transplants but preemergence to weeds, then control escaped weeds with metribuzin applied postemergence to crop and weeds. See instructions for chloramben and metribuzin above.
Germinating and emerged annual grasses and broadleaf weeds	diphenamid ENIDE (50 WP) followed by metribuzin[1] SENCOR (500 g/L) or LEXONE (75 DF)	4.5 to 6.75 kg/ha 9 to 13.5 kg/ha followed by 0.3 to 0.85 kg/ha 0.55 to 1.7 L/ha 0.32 to 1.1 kg/ha	Apply diphenamid preemergence to weeds shortly after tomatoes are transplanted, then follow with a directed postemergence application of metribuzin. See instructions for diphenamid and metribuzin above.

FIELD SEEDED TOMATOES

Preemergence

Germinating annual grasses and some annual broadleaf weeds	diphenamid ENIDE (50 WP)	4.50 to 6.75 kg/ha 9.0 to 13.5 kg/ha	Apply preemergence immediately after seeding. Rainfall is required to activate the herbicide. A shallow cultivation may be necessary to activate the herbicide in the absence of rainfall. Continued cultivation is required if annual broadleaf weeds are a problem.

Postemergence

Emerged annual grasses, wild proso millet, wild oats, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.15 to 0.30 kg/ha 0.8 to 1.6 L/ha 2 L/ha	Tomatoes are tolerant to Poast at any stage of growth. Apply Poast to emerged grasses in the 1- to 6-leaf stage during active growth while crop is small enough to permit thorough spray coverage. Complete control is normally obtained 7 to 21 days after application. A second application may be necessary to control grasses that emerge after the first treatment. Water rates of 50 to 200 L/ha provide the best results.
Quackgrass and annual grasses	sethoxydim POAST (184 g/L) plus oil concentrate ASSIST	0.8 kg/ha 4.4 L/ha 4 L/ha	Thorough preplant tillage will result in more uniform quackgrass emergence. Apply at 1 to 3 leaf stage of actively growing quackgrass in 110 to 200 L water per hectare. Crop competition and inter-row cultivation 7 to 14 days after application will provide quackgrass control for 6 to 8 weeks.

ORCHARDS

APPLES NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Germinating weeds	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	67 g CASORON 4 G applied to an area 2 × 2 m is equivalent to 175 kg per hectare. Use only under trees planted over one year. Do not use on light sandy soils.
	linuron** LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply as directed spray before weeds are 10 cm high in 400-600 L water per hectare. Add a surfactant. Avoid contact with fruit, foliage or tree bark with spray or drift. Use only under trees established at least 10 years.
	simazine* PRINCEP NINE-T (90 SG) SIMADEX (500 g/L)	2.25 to 4.5 kg/ha 2.5 to 5.0 kg/ha 4.5 to 9.0 L/ha	Apply in 300 to 1000 L water per hectare. Use only under trees planted for one year or more. Use higher rate on perennial grasses such as quackgrass.
	terbacil SINBAR (80 WP)	1.8 to 3.6 kg/ha 2.25 to 4.5 kg/ha	Apply in 1000 L water per hectare. Use only under trees established for at least three years.

APPLES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Emerged annual and perennial weeds	amitrole-t AMITROLE-T (240 g/L)	2.2-5.8 kg/ha 9 L-19 L/ha	Use at the rate of 4.5 L (product)/300 L water as a spot treatment on actively-growing weeds and grass under established apple trees. For grass and poison-ivy control, spray to wet all foliage. Keep spray off tree trunks as much as possible. DO NOT USE WITHIN 30 DAYS BEFORE HARVEST. May be combined with terbacil.
	amitrole/simazine (1:3) AMIZINE (60 WP)	2 kg/ha 7.7 kg/ha	Apply in 800 L water per hectare.
	glyphosate ROUNDUP (356 g/L)	Annual Weeds 0.85 to 1.25 kg/ha Quackgrass 1.70 to 2.50 kg/ha Other Perennials 2.5 to 4.25 kg/ha Annual Weeds 2.25 to 3.5 L/ha Quackgrass 4.75 to 7 L/ha Other Perennials 7 to 12 L/ha	Apply in 200 to 300 L of water per hectare. Remove all suckers from base of trunks before application. Do not apply within 30 days before harvest. Use preemergence herbicide to provide residual control of weed seedlings. For handgun applications use a 1% solution for quackgrass and annual weeds, and a 2% solution for other perennial weeds. Can be applied with wiper equipment. Refer to section on SELECTIVE WEED CONTROL WITH WIPER APPLICATORS. For SITE PREPARATION, refer to SPECIAL METHODS of WEED CONTROL.
	linuron** LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply as directed spray before weeds are 10 cm high in 400-600 L water per hectare. Add a surfactant. Avoid contact with fruit, foliage or tree bark with spray or drift. Use only under trees established at least 10 years.
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1100 L water per hectare or apply 55 mL in 10 L of water sprayed to wet weed foliage. Use on trees established 1 year or more. Paraquat can be used in mixtures with terbacil to provide residual vegetation control as well as a quick knock-down.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 to 5.5 kg/ha 5.5 to 11 L/ha	This commercial mixture can be used after weeds have emerged to provide quick "knock-down" of weeds as well as residual control for most of the growing season. Use only under trees established for at least one year.

Emerged grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	7.5 kg/ha 11 kg/ha 11 kg/ha	Use at the rate of 1.1 kg (product)/100 L water as a spot treatment on actively growing grasses. Spray to wet vegetation. Use only under apple trees established at least 4 years. Use only once per growing season.
	propyzamide KERB (50 WP)	2.25 kg/ha 4.5 kg/ha	Use only under apple trees established at least 1 year. 4.5 kg/ha is equivalent to 45 g/100 m^2.
Bindweed and other broadleaf perennials	MCPB TROPOTOX (400 g/L) MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 kg/ha acid 2.5 L/ha 1.1 kg/ha 2.5 L/ha	Apply in 180 to 1000 L water per hectare. Use as a directed spray under established trees as a spot treatment. Apply at low pressure as a coarse spray to wet leaves of bindweed, etc. Avoid contact with leaves, fruit, young growing shoots, suckers and green bark.

**SIMADEX (80 WP) equivalent rate is 2.75 to 5.5 kg/ha in 350 L water.*
**PRINCEP (80 WP) equivalent rate is 2.75 to 5.5 kg/ha.*
***LOROX L (480 g/L) equivalent rate is 9.0 L/ha.*

CAUTION: Simazine and terbacil residues high enough to harm many crops may persist for several years after removal of orchard.

APRICOTS

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare, or apply 55 mL in 10 L water sprayed to wet weed foliage. Use on trees established one year or more.

PEACHES

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Germinating weeds	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	67 g of CASORON 4 G applied to an area 2 × 2 m is equivalent to 175 kg/ha. Use only under trees planted over one year. Do not use on light, sandy soils.
	linuron* LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply in 400 to 600 L water per hectare as a directed spray before weeds are 12 cm high. Use only under peach trees established for over one year. Keep spray off leaves, fruit and green bark of trees. Add a surfactant.
	terbacil SINBAR (80 WP)	1.8 to 3.6 kg/ha 2.25 to 4.5 kg/ha	Apply in 1000 L of water per hectare. Use only under trees established for at least three years.
Emerged annual and perennial weeds	glyphosate ROUNDUP (356 g/L)	See under APPLES section for rates and remarks.	

PEACHES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Emerged annual and perennial weeds	linuron* LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply in 400 to 600 L water per hectare as a directed spray before weeds are 12 cm high. Use only under peach trees established for over one year. Keep spray off leaves, fruit and green bark of trees. Add a surfactant.
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare, or apply 55 mL in 10 L water sprayed to wet weed foliage. Use on trees established 1 year or more. Paraquat may be used as a tank-mix with linuron.

**LOROX L (480 g/L) equivalent rate is 9.0 L/ha.*

CAUTION: Terbacil residues, high enough to harm many crops, can persist for several years after removing orchard.

PEARS

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Germinating weeds	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	67 g of CASORON 4 G applied in an area 2 × 2 m is equivalent to 175 kg/ha. Use only under trees planted over one year. Do not use on light sandy soils.
	linuron** LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9.0 kg/ha 10.0 L/ha	Apply a directed spray before weeds are 10 cm high in 400 to 600 L water per hectare. Add a surfactant. Use only under pear trees established at least 10 years. Avoid contact with fruit, foliage or green bark with spray or drift.
	simazine* PRINCEP NINE-T (90 SG) SIMADEX (500 g/L)	2.25 to 4.5 kg/ha 2.5 to 5.0 kg/ha 4.5 to 9.0 L/ha	Apply in 300 to 1000 L of water per hectare. Use only under trees planted for one year or more.
Emerged annual and perennial weeds	glyphosate ROUNDUP (356 g/L)	See under APPLES and Notes on Chemicals sections for rates and remarks.	
	linuron** LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9.0 kg/ha 10.0 L/ha	Apply a directed spray before weeds are 10 cm high in 400 to 600 L water per hectare. Add a surfactant. Use only under pear trees established at least 10 years. Avoid contact with fruit, foliage or green bark with spray or drift.
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 l water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. Use on trees established 1 year or more.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 to 5.5 kg/ha 5.5 to 11 L/ha	This commercial mixture can be used on emerged weeds and grass to provide a quick "knock-down" of weeds as well as residual control for most of the growing season. Use only under trees established for at least one year.

Emerged grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	7.5 kg/ha 11 kg/ha 11 kg/ha	Use at the rate of 1.1 kg (product)/100 L water as a spot treatment on actively growing grasses. Spray to wet vegetation. Use only under pear trees established at least four years. Use only once per growing season.
	propyzamide KERB (50 WP)	2.2 kg/ha 4.5 kg/ha	Use only under pear trees established at least 1 year. 4.5 kg/ha is equivalent to 45 g/100 m^2.

**PRINCEP (80 WP) equivalent rate is 2.75 to 5.5 kg/ha*
**SIMADEX (80 WP) equivalent rate is 4.5 to 5.5 kg/ha*
***LOROX L (480 g/L) equivalent rate is 9.0 L/ha*

CAUTION: Simazine and terbacil residues high enough to harm many crops may persist for several years after removal of the orchard.

CHERRIES AND PLUMS

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Germinating weeds	dichlobenil CASORAN (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	67 g of CASORON 4 G applied to an area 2 × 2 m is equivalent to 175 kg/ha. Use only under trees planted over one year. Do not use on light, sandy soil.
	linuron* LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply in 400 to 600 L water per hectare as a directed spray before weeds are 12 cm high. Use only under trees established for ten years. Keep spray off leaves and green bark of trees.
Emerged annual and perennial weeds	glyphosate ROUNDUP (356 g/L)	See under APPLES section for rates and remarks.	
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare, or apply 55 mL in 10 L water sprayed to wet weed foliage. Use on trees established 1 year or more. Under trees established at least 10 years, linuron can be tank-mixed with paraquat to provide residual weed control.

**LOROX L (480 g/L) equivalent rate is 9.0 L/ha.*

GRAPES

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Germinating weeds	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply only to dormant healthy vines which have been established for at least two full years.

GRAPES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating weeds	diuron KARMEX (80 WP)	1.65 to 4.0 kg/ha 2.25 to 6.7 kg/ha	Apply in at least 300 L of water per hectare actually sprayed. Apply as a directed spray to a 1 m strip under vines. Where weed growth is heavy a rate of 4.5 kg/ha KARMEX (80 WP) is usually sufficient, except on heavy clay soils or on soils with a high organic matter content. Then the rate should be increased to 6.7 kg/ha. A maintenance application of 2.25 kg/ha KARMEX (80 WP) should be sufficient if applied before weed seeds germinate. Use only in vineyards established for at least 3 years. Applications may be made in the spring or fall, or both, but total amount applied in one year should not exceed 4.5 kg/ha KARMEX (80 WP), except on heavy clay or high organic matter soils as noted above.
	simazine* PRINCEP NINE-T (90 SG) SIMADEX (500 g/L)	3.6 to 4.5 kg/ha 4.0 to 5.0 kg/ha 7.2 to 9 L/ha	Apply in at least 300 L of water per hectare actually sprayed. Use only in vineyards established for at least 3 years. Established dandelions, field bindweed and quackgrass will not be controlled. Should control plantain.
Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. Use on vines established on trellises. Paraquat can be used in a tank-mix with diuron.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 to 5.5 kg/ha 5.5 to 11 L/ha	Apply in 500 L of water per hectare. See notes above for paraquat and simazine.
Bindweed, plantain and many broadleaf weeds and grasses	paraquat GRAMOXONE (200 g/L) plus MCPB or MCPB/MCPA (15:1) TROPOTOX or TROPOTOX PLUS	1.1 kg/ha 5.5 L/ha plus 1.1 kg/ha 2.75 L/ha	Apply in 1000 L water per hectare or apply 55 mL GRAMOXONE plus 30 mL TROPOTOX in 10 L water per 100 m^2. Apply in late May or early June, or for bindweed control, when bindweed starts to bloom. MCPB or MCPB/MCPA SPRAY OR DRIFT CAN INJURE GRAPES. Use only when necessary as a spot treatment. Use a hand sprayer or a hand-controlled wand fitted with a shielded nozzle. Use a low-pressure, coarse spray and direct spray to avoid contact with leaves and stems of grape vines.
Quackgrass, bindweed, and many other emerged broadleaf weeds and grasses	glyphosate	Annual Weeds 0.85 to 1.25 kg/ha Quackgrass 1.7 to 2.25 kg/ha Other Perennials 2.5 to 4.25 kg/ha	Apply in 200 to 300 L of water per hectare actually sprayed. Use preemergence herbicides to provide residual control of weed seedlings. DIRECT SPRAY TO AVOID LEAVES AND GREEN STEMS OF GRAPEVINES. Do not use on vines less than 3 years old. For handgun applications, use a 1% solution for quackgrass and annual weeds, and a 2% solution for other perennials. Can be applied with wiper equipment. Refer to section on SELECTIVE WEED CONTROL WITH WIPER

	ROUNDUP (356 g/L)	Annual Weeds 2.25 to 3.5 L/ha Quackgrass 4.75 to 7.0 L/ha Other Perennials 7.0 to 12 L/ha	APPLICATORS. For SITE PREPARATION, refer to SPECIAL METHODS OF WEED CONTROL section.
Quackgrass, thistles, bindweed and perennial weeds	dichlobenil CASORON (4 G)	7 to 9 kg/ha 175 to 225 kg/ha	Apply only to dormant, healthy vines that have been established at least two full years.

**PRINCEP (80 WP) equivalent rate is 4.5 to 5.5 kg/ha.*
**SIMADEX (80 WP) equivalent rate is 4.5 to 5.5 kg/ha.*

CAUTION: Diuron and simazine residues, high enough to harm many crops, can persist for several years after the removal of the vineyard.

SMALL FRUIT

CRANBERRIES

After Planting

Annual broadleaved species, certain sedges and *Juncus* species	dichlobenil CASORON (4 G)	4.4 kg/ha 110 kg/ha	Apply in early spring, pre-bloom. Temporary reddening of plants may occur, especially with late spring applications. Do not use on young beds or on newly sanded beds or on beds recently mowed for vines. Use lower rates of application on sandy bogs.
Emerged annual and perennial weeds	glyphosate ROUNDUP (356 g/L)		Apply with a rope wick or other similar device. Refer to section on SELECTIVE WEED CONTROL WITH WIPER APPLICATORS. Avoid contact with the cranberry vines.

CURRANTS AND GOOSEBERRIES **NOTE:** Recommended rates per hectare refer to area actually treated with herbicide.

Preplanting

Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS OF WEED CONTROL — SITE PREPARATION for rates and remarks.

After Planting

Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare, or apply 55 mL in 10 L of water as a spot treatment, sprayed to wet weed foliage. Direct the spray to wet the weeds but avoid wetting the leaves or green bark of the bushes.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
HIGHBUSH BLUEBERRIES NOTE: Recommended rates per hectare refer to area actually treated with herbicide.			
Preplanting			
Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		Refer to SPECIAL METHODS FOR WEED CONTROL — SITE PREPARATION section for rates and remarks.
After Planting			
Germinating weeds	dichlobenil CASORON (4 G)	7.0 to 9.0 kg/ha 175 to 225 kg/ha	67 g CASORON 4 G applied to an area 2 × 2 m is equivalent to 175 kg per hectare. Use only under plants established for at least three years. Do not use on light, sandy soil.
	simazine* PRINCEP NINE-T	2.25 to 3.4 kg/ha 2.5 to 3.75 kg/ha	Apply in 300 to 1000 L water per hectare before weed emergence. Use only on established plants.
	terbacil SINBAR (80 WP)	2.2 to 3.4 kg/ha 2.75 to 4.25 kg/ha	Apply in 200 to 1000 L water per hectare. Use only in plantings established in the field for at least 1 year. Make one application per year.
Emerged annual and perennial weeds	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1100 L water per hectare or apply 55 mL of product in 10 L of water sprayed to wet weed foliage. Use on plantings established one year.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 kg/ha 5.5 L/ha	Apply to established plantings only. Use a directed spray. See comments above on paraquat and simazine.

**PRINCEP (80 WP) equivalent rate is 2.8 to 4.25 kg/ha.*

CAUTION: Terbacil and simazine residues, high enough to harm many crops, can persist for several years after removal of a planting.

RASPBERRIES AND BLACKBERRIES NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Preplanting

Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS OF WEED CONTROL — SITE PREPARATION section for rates and remarks.

After Planting

Germinating weeds and grasses	simazine** PRINCEP NINE-T (90 SG) SIMADEX (500 g/L)	1.8 to 2.25 kg/ha 2.0 to 2.5 kg/ha 3.6 to 4.5 L/ha	Apply in 300 to 1000 L of water per hectare actually sprayed. Apply as a directed spray early in the spring before the weeds emerge. Keep spray off young shoots. Do not use in first-year plantings. Do not exceed recommended rate.
Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. Direct spray at base of canes in the spring before new shoots emerge.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 kg/ha 5.5 L/ha	This commercial mixture can be used on established plantings only to control emerged weeds and grasses and to provide residual control. Do not spray young raspberry shoots. See notes concerning simazine and paraquat above.
Emerged broadleaf weeds	2,4-D Amine 2,4-D (500 g/L)*	0.55 kg/ha 1.0 L/ha	Apply in 100 to 200 L of water per hectare actually sprayed. Do not spray when plants are in bloom. Keep spray off new shoots as much as possible. Spot spraying at a rate equivalent to 1 kg/ha may be necessary to control established dandelions and other broadleaf weeds.
Emerged grasses including quackgrass	dalapon DOWPON M (74 SP) DALAPON (74 SP) BASFAPON (74 SP)	0.75 kg/100 L water 1.0 kg/100 L water 1.0 kg/100 L water 1.0 kg/100 L water	Apply as a spot treatment to actively growing grasses. Spray to wet grass foliage. Apply early in the spring or in the fall. Direct spray to avoid new shoots.
Quackgrass, perennial and annual weeds	dichlobenil CASORON (4 G)	7.0 kg/ha 175 kg/ha	Apply on established raspberry plantings in late fall. Do not cultivate or work into the soil. DO NOT APPLY IN THE SPRING as injury may result.

**Additional formulations are available. Use rates to give comparable amounts of active ingredient. (See Table 1).*
***PRINCEP (80 WP) equivalent rate is 2.25 to 2.75 kg/ha.*
***SIMADEX (80 WP) equivalent rate is 2.25 to 2.75 kg/ha.*

STRAWBERRIES

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

Preplanting

Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS OF WEED CONTROL — SITE PREPARATION section for rates and remarks.

Planting Year 2 to 6 weeks after planting

Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds or following a clean cultivation. Shallow cultivation to incorporate chemical into soil surface may improve weed control. Do not apply more than three applications during the planting year.

STRAWBERRIES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Germinating weeds	diphenamid ENIDE (50 WP)	4.5 to 6.75 kg/ha 9 to 13.5 kg/ha	Apply preemergence to the weeds or following a clean cultivation.
Emerged broadleaf annual seedlings	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare before weeds are 3 to 5 cm high. Do not use more than three applications during the planting year.
	2,4-D amine 2,4-D (500 g/L)*	0.55 kg/ha 1.1 L/ha	Apply in 100 to 200 L of water per hectare. Use low pressure and a coarse spray to minimize risk of spray drift to susceptible crops. Do not use after early runners start to root in June, or between mid-August and fall dormancy when flower buds are developing for next year's crop.

**Additional formulations are available. Use rates to give comparable amounts of active ingredient. (See Table 1.)*

Planting Year 4 to 6 weeks after planting

Germinating and seedling weeds	terbacil SINBAR (80 WP)	220 to 440 g/ha 275 to 550 g/ha	Apply in at least 300 L of water per hectare when mother plants are well established but before runnering becomes extensive and new runner plants are rooting. Apply preemergence or early postemergence to the weeds. Use lower rate on sandy soils low in organic matter and on sensitive varieties such as Earlidawns, Midway, Micmac, Bounty and Kent. Weak or diseased plants may be severely injured. Accurate calibration of sprayer is essential to avoid crop injury. Do not overlap spray swaths. Shallow cultivation can be done to train runners and control weed escapes without destroying the activity of terbacil.

Late Summer and Fall — Planting and harvesting years

Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds, following clean cultivation.
Chickweed and small broadleafs	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare, early postemergence to weeds or to growing chickweed.
Germinating and seedling weeds	terbacil SINBAR (80 WP)	150 to 220 g/ha 180 to 275 g/ha	Apply in at least 300 L of water per hectare, preemergence or early postemergence to the weeds. See remarks on terbacil above.

Late Fall — Planting and harvesting years

Wheat, winter annuals and weeds germinating in early spring	terbacil SINBAR (80 WP)	550 to 770 g/ha 700 to 850 g/ha	Apply in at least 300 L of water per hectare just prior to mulching. Use low rate where it is planned to use terbacil again in the spring. See remarks on terbacil above.

Spring — Harvesting Years

Seedling weeds	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare early postemergence to the weeds or to growing chickweed. DO NOT APPLY within 60 days of harvest.
Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds, immediately after removing the mulch.
Germinating and seedling weeds	terbacil SINBAR (80 WP)	220 to 280 g/ha 275 to 350 g/ha	Apply in at least 300 L of water per hectare immediately after mulch is removed. Strawberry plants that have made weak yellow growth under the mulch may be severely injured. See remarks on terbacil above.

After-Harvest Renovation

Dandelions and other broadleaf weeds	2,4-D amine 2,4-D (500 g/L)*	1.1 kg/ha 2.2 L/ha	Apply after harvest but before mowing to control dandelions and other broadleaf perennials. Delay mowing for a few days after application. Do not apply 2,4-D between mid-August and fall dormancy because of its possible effect on flower bud formation. Veestar is more sensitive to 2,4-D than Redcoat.
Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds after mowing and narrowing the rows.
Seedling weeds	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare early postemergence to the weeds.
Germinating and seedling weeds	terbacil SINBAR (80 WP)	550 to 700 g/ha 700 to 850 g/ha	Apply in at least 300 L of water per hectare preemergence or early postemergence to the weeds. If 2,4-D was used prior to mowing, delay applying terbacil for at least 2 weeks. See remarks on terbacil above.

**Additional formulations are available. Use rates to give comparable amounts of active ingredient. (See Table 1.)*

CAUTION: Residues high enough to harm some crops can persist in the soil for over a year after using TERBACIL. Residues are likely to be higher on heavier soil types.

ORNAMENTAL CROPS

TURFGRASS (LAWNS, PARKS AND GOLF COURSES)

Vigorous growth of an adapted grass is the key to keeping lawn areas free of weeds. Proper lawn maintenance with the application of fertilizers is essential. The reader is referred to publications on this subject available from Agriculture Canada and the Ontario Ministry of Agriculture and Food. (See addresses located near the end of this publication.) The 2,4-D spray is most effective in the spring, or in September when the weeds are growing well. The treatment will generally thin Dutch clover in the lawn. Mecoprop, dichlorprop, and dicamba will control a number of weeds resistant to 2,4-D. As with 2,4-D, a thorough wetting of the weed foliage is emphasized. Mecoprop, dichlorprop and dicamba are also sold in mixtures with 2,4-D. Mecoprop is safer to use on bent grass than 2,4-D.

Mixtures containing dicamba should not be used close to shrubs, etc., at rates above 425 g (active) per hectare. Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed which is resistant to most other herbicides except when very young. After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade, and eventually crowd out much of the grass population. Mowing at a height of 6 to 8 cm will eliminate many such weeds. If they are extremely thick, 2,4-D at one-half the usual concentration (1.1 kg in 800 L water/ha) or mecoprop (1.1 kg in 400 L water/ha) can be used — but not before the grass has been up at least 4 weeks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Dandelions, plantains and many broadleaf weeds	2,4-D amine	**Follow manufacturer's directions**	
Chickweeds, clovers, black medick, and other 2,4-D-resistant weeds, including knotweed when young	mecoprop dichlorprop	0.8 to 1.3 kg in 200-400 L water/ha	**WARNING** — Since lawns are generally associated with a wide range of ornamentals and flowers that are susceptible to 2,4-D, dichlorprop, dicamba or mecoprop, particular care must be taken in the application of these chemicals.
	2,4-D/mecoprop 2,4-D/dicamba 2,4-D/dichlorprop 2,4-D/mecoprop/dicamba	**Follow manufacturer's directions**	
Crabgrass	bensulide PRE-SAN (480 g/L)* BETASAN (12.5% Gr)	11 to 16.5 kg/ha 23.1 L to 34.6 L/ha 88 to 132 kg/ha	Apply before crabgrass emergence in early spring, or in fall to establish turf. Use the higher rate for fall application only if no reseeding has been done in the fall.
	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (2.3% Gr)**	11.6 to 20.3 kg/ha 15.5 to 27 kg/ha 504 to 882 kg/ha	
	siduron	9 to 13.5 kg/ha	Crabgrass may be controlled in a newly seeded area by applying siduron (TUPER-

	TUPERSAN	(available as fertilizer mix only)	SAN) at 6.75 kg (active) per hectare. This chemical must be applied after seeding but preemergence to the crabgrass seedlings. Apply only in early spring. Follow manufacturer's directions especially when applying to certain bentgrass strains.
Annual bluegrass (Poa annua)	bensulide PRE-SAN (480 g/L)* BETASAN (12.5% Gr)	13.5 to 16.5 kg/ha 28.4 to 34.6 L/ha 108 to 132 kg/ha	Repeated treatments will be required. Reseeding the area will not be possible for one year following treatment.
	chlorthal-dimethyl DACTHAL (75 WP) DACTHAL (2.3% Gr)**	11.6 to 20.3 kg/ha	

Also available as BETASAN (480 g/L) and may be applied at same rates as PRE-SAN.
***DACTHAL 5.0% Gr use 232 to 406 kg/ha.*

Emerged yellow nutsedge	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha 2 L/ha	Top growth of nutsedge is controlled by 2 applications 10 days apart.

NOTE: To convert kg or L/ha to g or mL/100 m^2 multiply by 10 (example: 11 kg/ha becomes 110 g/100 m^2 and 28.4 L/ha becomes 284 mL/100 m^2).

TURFGRASS RENOVATION

The turf to be renovated should be mowed and thoroughly raked to remove all dead and cut vegetation. Apply paraquat (GRAMOXONE) at a rate of 2.0 kg (active) to 10 L (product) in 1,000 L water per hectare. This treatment will "burn off" all emerged vegetation. When the old turf is dead, rotovate top 5 cm to cover dead grass, rake the surface to prepare seedbed and reseed.

Glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water per hectare after omitting at least one regular mowing. Tillage should be delayed 7 days after application to allow for proper translocation into underground plant parts. Direct seeding into the killed turf (no tillage) may be carried out.

TURFGRASS RETARDATION

Reduction in grass growth may be brought about by treatment with maleic hydrazide (ROYAL MH 60 SG, 6.5 to 8.0 kg/ha product). Manufacturer's directions should be followed carefully. This chemical is recommended for use in areas where mowing and trimming are difficult and where a lawn-like appearance is not necessary (see "Notes on Chemicals" section).

TURFGRASS ESTABLISHMENT

When it is desired to establish turfgrass in areas that are heavily infested with weeds such as quackgrass, the area should be treated with gylphosate (ROUNDUP) prior to the preparation of the seedbed.

Use glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water applied postemergence when quackgrass is actively growing and has at least four leaves. Allow 7 or more days after application before tillage. For maximum quackgrass control a repeat treatment may be necessary before grass establishment. If retreatment is necessary, wait until quackgrass has reached the 3- to 4-leaf stage.

For other perennial weeds follow label instructions for proper rate and stage of growth.

ORNAMENTAL CROPS

TURFGRASS (LAWNS, PARKS AND GOLF COURSES)

Vigorous growth of an adapted grass is the key to keeping lawn areas free of weeds. Proper lawn maintenance with the application of fertilizers is essential. The reader is referred to publications on this subject available from Agriculture Canada and the Ontario Ministry of Agriculture and Food. (See addresses located near the end of this publication.) The 2,4-D spray is most effective in the spring, or in September when the weeds are growing well. The treatment will generally thin Dutch clover in the lawn. Mecoprop, dichlorprop, and dicamba will control a number of weeds resistant to 2,4-D. As with 2,4-D, a thorough wetting of the weed foliage is emphasized. Mecoprop, dichlorprop and dicamba are also sold in mixtures with 2,4-D. Mecoprop is safer to use on bent grass than 2,4-D.

Mixtures containing dicamba should not be used close to shrubs, etc., at rates above 425 g (active) per hectare. Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed which is resistant to most other herbicides except when very young. After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade, and eventually crowd out much of the grass population. Mowing at a height of 6 to 8 cm will eliminate many such weeds. If they are extremely thick, 2,4-D at one-half the usual concentration (1.1 kg in 800 L water/ha) or mecoprop (1.1 kg in 400 L water/ha) can be used — but not before the grass has been up at least 4 weeks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Dandelions, plantains and many broadleaf weeds	2,4-D amine	**Follow manufacturer's directions**	
Chickweeds, clovers, black medick, and other 2,4-D-resistant weeds, including knotweed when young	mecoprop dichlorprop	0.8 to 1.3 kg in 200-400 L water/ha	**WARNING** — Since lawns are generally associated with a wide range of ornamentals and flowers that are susceptible to 2,4-D, dichlorprop, dicamba or mecoprop, particular care must be taken in the application of these chemicals.
	2,4-D/mecoprop 2,4-D/dicamba 2,4-D/dichlorprop 2,4-D/mecoprop/dicamba	**Follow manufacturer's directions**	
Crabgrass	bensulide PRE-SAN (480 g/L)* BETASAN (12.5% Gr)	11 to 16.5 kg/ha 23.1 L to 34.6 L/ha 88 to 132 kg/ha	Apply before crabgrass emergence in early spring, or in fall to establish turf. Use the higher rate for fall application only if no reseeding has been done in the fall.
	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (2.3% Gr)**	11.6 to 20.3 kg/ha 15.5 to 27 kg/ha 504 to 882 kg/ha	
	siduron	9 to 13.5 kg/ha	Crabgrass may be controlled in a newly seeded area by applying siduron (TUPER-

	TUPERSAN	(available as fertilizer mix only)	SAN) at 6.75 kg (active) per hectare. This chemical must be applied after seeding but preemergence to the crabgrass seedlings. Apply only in early spring. Follow manufacturer's directions especially when applying to certain bentgrass strains.
Annual bluegrass (Poa annua)	bensulide PRE-SAN (480 g/L)* BETASAN (12.5% Gr)	13.5 to 16.5 kg/ha 28.4 to 34.6 L/ha 108 to 132 kg/ha	Repeated treatments will be required. Reseeding the area will not be possible for one year following treatment.
	chlorthal-dimethyl DACTHAL (75 WP) DACTHAL (2.3% Gr)**	11.6 to 20.3 kg/ha	

Also available as BETASAN (480 g/L) and may be applied at same rates as PRE-SAN.
***DACTHAL 5.0% Gr use 232 to 406 kg/ha.*

Emerged yellow nutsedge	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha 2 L/ha	Top growth of nutsedge is controlled by 2 applications 10 days apart.

NOTE: To convert kg or L/ha to g or mL/100 m^2 multiply by 10 (example: 11 kg/ha becomes 110 g/100 m^2 and 28.4 L/ha becomes 284 mL/100 m^2).

TURFGRASS RENOVATION

The turf to be renovated should be mowed and thoroughly raked to remove all dead and cut vegetation. Apply paraquat (GRAMOXONE) at a rate of 2.0 kg (active) to 10 L (product) in 1,000 L water per hectare. This treatment will "burn off" all emerged vegetation. When the old turf is dead, rotovate top 5 cm to cover dead grass, rake the surface to prepare seedbed and reseed.

Glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water per hectare after omitting at least one regular mowing. Tillage should be delayed 7 days after application to allow for proper translocation into underground plant parts. Direct seeding into the killed turf (no tillage) may be carried out.

TURFGRASS RETARDATION

Reduction in grass growth may be brought about by treatment with maleic hydrazide (ROYAL MH 60 SG, 6.5 to 8.0 kg/ha product). Manufacturer's directions should be followed carefully. This chemical is recommended for use in areas where mowing and trimming are difficult and where a lawn-like appearance is not necessary (see "Notes on Chemicals" section).

TURFGRASS ESTABLISHMENT

When it is desired to establish turfgrass in areas that are heavily infested with weeds such as quackgrass, the area should be treated with gylphosate (ROUNDUP) prior to the preparation of the seedbed.

Use glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water applied postemergence when quackgrass is actively growing and has at least four leaves. Allow 7 or more days after application before tillage. For maximum quackgrass control a repeat treatment may be necessary before grass establishment. If retreatment is necessary, wait until quackgrass has reached the 3- to 4-leaf stage.

For other perennial weeds follow label instructions for proper rate and stage of growth.

ANNUAL FLOWERS **Warning:** Certain varieties may be injured by the following herbicides. Check manufacturer's directions before use.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Preplanting			
Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS FOR WEED CONTROL — Site preparation section for rates and remarks.
Preplant Incorporated			
Germinating seeds	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.2 to 2.1 L/ha	Trifluralin must be incorporated before transplanting. Do not use for seeded annuals. Check label for list of tolerant species.
Established Plants — Preemergence			
Seedling annuals and germinating seeds	chloramben ORNAMENTAL WEEDER (4 G) WEEDONE GARDEN WEEDER (1.2 G)	4.5 kg/ha 1.1 kg/100 m^2 3.7 kg/100 m^2	Chloramben is applied as a granular formulation to weed-free areas around established plants. Check label for list of tolerant ornamental plants.
	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (5 G)	6.75 to 12.5 kg/ha 9 to 16.5 kg/ha 1.4 to 2.5 kg/100 m^2	Apply the wettable powder in 150 to 300 L water per hectare before weed emergence. Use only around established transplants.
	EPTC EPTAM (2.3 G)	5.75 to 6.9 kg/ha 250 to 300 kg/ha	Use on mineral soils only. Use the granular formulation at the lower rate after the plants are established. Apply when the leaves are dry and use sprinkler irrigation to incorporate.

GLADIOLI

Preplant			
Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)		**Preplanting** — See under SPECIAL METHODS FOR WEED CONTROL — Site preparation section for rates and remarks.

Preemergence

Seedling annuals and germinating seeds	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (5 G)	6.75 to 12.5 kg/ha 9 to 16.5 kg/ha 1.4 to 2.5 kg/100 m^2	Apply preemergence for annual grass control.
	diuron KARMEX (80 WP)	0.9 to 1.75 kg/ha 1 to 2 kg/ha	Apply preemergence in at least 200 L water per hectare.
	linuron LOROX, AFOLAN (50 WP)	1.75 to 3.25 kg/ha 3.5 to 6.5 kg/ha	Use preemergence in 250 to 400 L water per hectare. Do not use on small corms. Any gladioli shoots exposed should be covered with soil.
	chloramben ORNAMENTAL WEEDER (4 G) WEEDONE GARDEN WEEDER (1.2 G)	4.5 kg/ha 1.1 kg/100 m^2 3.7 kg/100 m^2	These granular formulations are available for the home gardener.

Preemergence or Postemergence to Crop

Seedling annuals and germinating seeds	chlorpropham CIPC (480 g/L) CIPC (20 G)	5.5 kg/ha 11.6 L/ha 27.5 kg/ha or 275 g/100 m^2	May be applied either pre- or postemergence to the gladioli. When used postemergence apply as a directed spray or use the granular formulation. Particularly effective against purslane. Apply after a clean cultivation, when the soil is moist in 200 to 400 L per hectare.

IRIS

Preplant

Quackgrass and many other weeds	glyphosate ROUNDUP (356 g/L)	**Preplanting** — See under SPECIAL METHODS FOR WEED CONTROL — Site Preparation section for rates and remarks.

Postemergence to Crop, Preemergence to Weeds

Seedling annuals and germinating seeds	chloramben ORNAMENTAL WEEDER (4 G) WEEDONE GARDEN WEEDER (1.2 G)	4.5 kg/ha 1.1 kg/10 m^2 3.7 kg/10 m^2	Granular formulations suitable for the home garden trade. Apply after a clean cultivation when the leaves of the iris plants are dry.

WOODY NURSERY STOCK

Warning: Certain types of woody nursery stock may be injured by the following herbicides. Check manufacturer's directions before use. CIPC (chlorpropham) should not be used on tree-fruit nursery stock.

Preplant

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Quackgrass and many other emerged weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS FOR WEED CONTROL — Site Preparation section for rates and remarks.

Preplant Incorporated

Seedling annuals and germinating weeds	EPTC EPTAM (2.3 G)	6 kg/ha 0.3 kg/10 m^2	Apply to a dry soil surface and incorporate immediately with a heavy rake or cultivator.
	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha	Must be incorporated immediately after application, after a clean cultivation. This treatment does not control ragweed, annual nightshade or mustards, and lady's-thumb may escape the treatment. Annual grass control is usually excellent.

After Planting and In Established Plantings

Warning: Refer to manufacturer's instructions for waiting period required after planting.

Preemergence

Seedling annuals and germinating seeds	chlorpropham CIPC (20 G)	6.8 to 11 kg/ha 34 to 55 kg/ha	Apply the granular formulation after a clean cultivation when the soil is moist.
	chloramben ORNAMENTAL WEEDER (4 G) WEEDONE GARDEN WEEDER (1.2 G)	4.5 kg/ha 1.1 kg/10 m^2 3.7 kg/10 m^2	Apply preemergence to the weeds, when the soil is warm and moist.
	chlorthal dimethyl DACTHAL (75 WP)	9 to 16.5 kg/ha 12 to 22 kg/ha	Apply preemergence for annual weed control.

	diphenamid ENIDE (50 WP)	6.75 to 9 kg/ha 13.5 to 18 kg/ha	Apply in the fall directly over established nursery stock. Apply to clean cultivated land as established weeds are not controlled. Should control many winter annual and annual weeds through the following spring.
	simazine PRINCEP NINE-T (90 SG)	2.25 to 3.38 kg/ha 2.5 to 3.75 kg/ha	Apply before weeds emerge on established plantings only. Nursery stock can be injured by a residue in the soil if this herbicide is used where stock is removed, and replaced with another planting. This herbicide cannot be used around ornamental shrubs if the area is to be underplanted to ground cover or bedding plants.
Quackgrass	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in the late fall as a granular application. Apply in cool weather. Check label for tolerant species.
	propyzamide KERB (50 WP)	1.5 kg/ha 3.0 kg/ha	Apply in the late fall when the soil temperature is low but above freezing. Soil moisture should be high. This herbicide is absorbed through the roots.

Preemergence Incorporated

Note: Incorporate as closely as possible to plants without damaging roots.

Seedling annuals and germinating seeds	EPTC EPTAM (2.3 G)	6 kg/ha 0.3 kg/10 m^2	Apply to a dry soil surface and incorporate immediately with a heavy rake or cultivator.
	trifluralin TREFLAN (545 g/L) RIVAL (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha 1.2 to 2.3 L/ha	Apply to weed-free soil. Incorporate after application. This treatment does not control ragweed, annual nightshade or mustards, and lady's-thumb may escape the treatment. Annual grass control is usually excellent.

Postemergence

Emerged annual weeds	glyphosate ROUNDUP (356 g/L)	0.8 to 1.25 kg/ha 2.2 to 3.5 L/ha	Apply to actively growing weeds. Do not allow spray to contact leaves or green bark of trees or shrubs (see also, SELECTIVE WEED CONTROL WITH WIPER APPLICATORS section).
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Use as a chemical mower and as such can be used several times during the year. Direct spray to avoid the leaves or green bark of nursery plants. For spot treatment use 25 mL product in 4 L water.
Emerged perennial weeds	glyphosate ROUNDUP (356 g/L)	1.75 to 3.75 kg/ha 4.9 to 10.5 L/ha	For the control of quackgrass, apply glyphosate at 1.75 to 2.50 kg/ha when the quackgrass has at least 4 new leaves on each shoot. Canada thistle should be in the early bud stage, field bindweed in full flower, and milkweed at the bud stage of growth. Use 2.5 to 3.75 kg/ha in 200 to 400 L water per hectare as a directed spray in established nursery plantings (see also, SELECTIVE WEED CONTROL WITH WIPER APPLICATORS section).

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
SHELTERBELTS (WINDBREAKS)			
Transplanted Shelterbelts (Windbreaks)			
Preplant			
Quackgrass and many other emerged weeds	glyphosate ROUNDUP (356 g/L)		See under SPECIAL METHODS FOR WEED CONTROL — Site Preparation section for rates and remarks.
Preplant Incorporated			
Germinating annual grasses, lamb's-quarters, pigweed, chickweed, and purslane	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha	Apply after a clean cultivation, and incorporate after application. Transplant the trees or shrubs so that most of their root system is placed below the treated layer of soil.
Established Shelterbelts (Windbreaks)			
Germinating annual grasses, lamb's-quarters, pigweed, chickweed, and purslane	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha	Apply as a directed spray to the soil surface around the trees or shrubs. Incorporate as closely as possible to the trees and shrubs without causing damage to their roots.
Germinating weeds	simazine PRINCEP NINE-T (90 SG)	2.25 to 3.37 kg/ha 2.5 to 3.75 kg/ha	Apply in the fall or spring prior to weed emergence or after emerged weeds have been removed. Windbreak species must be established for at least one year. Tolerant species include cedar, spruce, black walnut, white ash, green ash, elm, boxelder, maple and caragana. Check label for species which will tolerate higher rates of simazine. Apply before buds break in spring. Use low rate for sandy soils or low organic matter soils.
Quackgrass	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in the late fall (October 15 to December 15) as a granular application. Tolerant species include cedar, linden, maple, willow, caragana and ash.
Emerged annual and perennial weeds	glyphosate	Annual Weeds 0.85 to 1.25 kg/ha Quackgrass 1.70 to 2.50 kg/ha Other Perennials 2.5 to 4.25 kg/ha	Apply in 200 to 300 L of water per hectare. Apply to actively growing weeds as a directed spray. For quackgrass control, apply when grass has at least four new leaves. Canada thistle should be at least in early bud, milkweed at the bud, and bindweed at full flower for best results. Remove all suckers from base of trunks before application. Do not allow spray or drift to contact leaves or green bark of trees. Use preemergence herbicide to provide residual control of weed seedlings (see also,

	ROUNDUP (356 g/L)	Annual Weeds 2.25 to 3.5 L/ha Quackgrass 4.75 to 7 L/ha Other Perennials 7 to 12 L/ha	SELECTIVE WEED CONTROL WITH WIPER APPLICATORS section). Applications may be made where following species are grown: ash, caragana, cherry, elm, lilac, maple, mountain ash, poplar, Russian olive, willow, pine, spruce, fir or yew.
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare, or apply 55 mL in 10 L of water, sprayed to wet weed foliage. More than one treatment may be necessary during the season since paraquat leaves no residue on the soil.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	7.0 to 8.5 kg/ha 14.0 to 17.0 L/ha	This commercial mixture can be used after weeds have emerged to provide quick "knock-down" of weeds as well as residual control for most of the growing season. Use only under trees established for at least one year. Apply in 500 L water per hectare to trees established at least one year. Applications may be made to the following species: caragana, green ash, Siberian and American elm and boxelder maple. Injury may occur to trees growing on saline soils.

OTHER HORTICULTURAL USES

DRIVEWAYS, PATIOS AND PATHS

Many broadleaf weeds and grasses	ammonium sulfamate POISON-IVY & BRUSH KILLER (500 g/L)	0.15 kg in 4.5 L water 0.3 kg in 4.5 L water	Ammonium sulfamate is not selective, that is, it will kill all plants on which it is sprayed. Spray enough to wet weed foliage. Wash all spray equipment immediately after use as this chemical is very corrosive.
	paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha	Apply in 275 L water per hectare. This chemical is not available to the home gardener but can be used by nurserymen, landscape contractors and farmers. It should be applied as a directed spray to avoid wetting the leaves and green bark of shrubs, and other garden plants. For spot treatments use 30 mL of product in 10 L water per 100 m^2.
	paraquat C.I.L. WEED & GRASS KILLER WEED-BAN	Follow directions on label.	This product is packaged in small quantities for the home garden trade. The granules are readily dissolved in water so that application can be made with a watering-can or garden sprayer. It is used as a "chemical mower." Use low pressure and a coarse spray to prevent drift onto lawns, flowers, vegetables, and green leaves of other desirable plants. See note above.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
ERADICATING PERSISTENT PERENNIALS OR SHRUBS			
Shrubs or herbaceous perennials	ammonium sulfamate POISON-IVY KILLER	30 mL per 100 m^2 60 mL per 100 m^2	The treatment with ammonium sulfamate is useful in handling persistent weeds, perennials that have become too aggressive, or shrubs such as lilacs, in garden areas. The chemical at the above rates will render the soil barren for about one season. However, it will break down in time, and the soil fertility will not be impaired. Damage may occur to desirable trees or other plants with roots that enter the treated area, or to plants located in lower portions of the garden onto which the chemical has been washed. Due precautions should be taken.
SEEDBEDS AND POTTING SOIL			
Seeds of most weeds	dazomet BASAMID (98 G) MYLONE	 0.50 kg/10 m^2 0.60 kg/10 m^2	See NOTES ON CHEMICALS section. Refer to manufacturer's directions for specific details as well as direction on sealing soil, evacuating gases and performing the safety germination test. Do not use below 6°C.
	methyl bromide/chloropicrin TERR-O-GAS	Follow manufacturer's direction	A poisonous gas which must be applied under a gas-proof cover (usually plastic). Its use is subject to the Pesticides Act. It may be used by the grower on his own seedbeds but he must obtain a permit from the Ontario Ministry of the Environment each time it is used. The manufacturer's instructions must be followed, and the seedbed or greenhouse aired thoroughly after the treatment period. If there is any question, the safety precautions in the Pesticides Act should be studied, or inquiry made at the local office of the Ontario Ministry of Agriculture and Food or the Ontario Ministry of the Environment.
	metam sodium VAPAM	 1.25 L/10 m^2	Apply as a drench to a soil that should be wet to a depth of at least 8 cm. Do not plant for 10 to 14 days or longer if the weather is cool.
	methyl isothiocyanate/ dichloropropene VORLEX PLUS	 0.2 to 1.0 kg/10 m^2	A liquid soil fumigant which is injected into the prepared seedbed by means of special applicators.
	methyl isothiocyanate/ dichloropropene/ chloropicrin VORLEX PLUS CP	 0.2 to 1.0 kg/10 m^2	Chloropicrin provides additional disease control to the mixture.

SPECIAL METHODS OF WEED CONTROL

Site Preparation

Quackgrass, Canada thistle, bindweed, and any emerged annual broadleaf weeds and grasses	glyphosate	Annual weeds 0.85 to 1.25 kg/ha Quackgrass 0.9 to 2.5 kg/ha Other perennials 2.5 to 4.25 kg/ha	Glyphosate can be applied to actively growing weeds in the fall, or spring prior to planting any crop. Application to annual weeds will only control those emerged. Annual weed control programs will be necessary to control weeds germinating after planting. For quackgrass control apply when at least 4 new leaves are present. The low rate (2.6 L/ha) will provide one-season control, while higher rates (4.75 to 7 L/ha) will provide longer term control. The low rate must be applied in 50 to 100 L/ha water using flat fan nozzles. The higher rates may be applied in 200 to 300 L/ha water. Canada thistle should be at least in early bud, milkweed at bud and bindweed at full flower for best results. Delay cultivation 5 days or more after application.
	ROUNDUP (356 g/L)	Annual weeds 2.4 to 3.5 L/ha Quackgrass 2.6 to 7.0 L/ha Other perennials 7.0 to 12.0 L/ha	

Stale Seedbed and Inter-Row Weeding

	paraquat or diquat GRAMOXONE or REGLONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha	One of these herbicides may be used to kill emerged weeds on a prepared seedbed before the crop seed is sown. Check label for list of crops for which this technique is registered. In inter-row weeding, special low-pressure equipment is used to apply the herbicide on emerged weeds without contact with leaves of the crop plants. For small areas apply 30 mL product in 10 L water per 10 m^2.
	paraquat/diquat C.I.L. WEED & GRASS KILLER WEED-BAN	See label.	DOMESTIC — Soluble granular formulation for home gardener use. Check label rates.

Selective Weed Control With Wiper Applicators

Milkweed, Canada thistle, quackgrass, lamb's-quarters, and other weeds	glyphosate ROUNDUP (356 g/L)		Check label for list of crops for which this technique is registered. Apply glyphosate with a rope-wick or other similar device using a 33% solution (1 litre ROUNDUP in 2 litres water). A roller applicator may be used with a 5 to 10% solution (0.5 to 1.0 L in 9.0 L water). The wiper should contact at least the top 15 cm of the weeds. The wiper should also be kept at least 15 cm above desirable vegetation to avoid injury. Vehicle speed should be 4-10 km/hr. Two passes may be beneficial, especially in heavy weed infestations and at higher vehicle speeds. In orchards, vineyards and shelter belts etc., do not contact sucker growth. (Follow manufacturer's directions.)

ROADSIDES AND NON-CROP AREAS

Fencerows and Farm Areas

In agricultural areas, weeds growing in fencerows, around buildings and on roadsides are sources of potential weed infestation to other parts of a farm. In addition, brush and weeds around fields harbor insects, diseases, and other pests that may be detrimental to farming operations, or shrubs like wild cherry may be possible sources of livestock poisoning. Farmers may also wish to reclaim land on which willows or brush have encroached.

It is also important to keep drainage ditches and farm ponds free of troublesome aquatic vegetation.

Roadsides, Rights-of-way and Waste Places

Road maintenance personnel are interested in controlling weeds and brush to reduce the cost of winter snow-removal programs. Low vegetation will also give the road-user a clear view of other vehicles, animals, children, and other hazards. It is important to prevent brush encroachment onto the roadway proper, to keep the drainage ditches open to prevent flooding, and to minimize the fire hazard of tall, dry vegetation in late summer. A grass cover also prevents soil erosion much better than weeds.

In some situations (i.e., hard-to-mow areas) chemical growth retardants can be used to reduce grass growth.

Both railway and power-supply authorities are concerned with maintaining safe and accessible rights-of-way by controlling growth of weeds and brush.

In certain areas (beneath guide rails, in storage yards, under railway tracks and under fences at road intersections), it may be advantageous to completely kill all vegetation for a longer period of time. Chemicals and suggestions for their use in this way are presented in the section on "Long-term Total Vegetation Control."

In roadside and right-of-way spraying, for weed control or brush control, precautions should always be taken to minimize herbicide drift. It is advisable to inspect or monitor each roadside just prior to spraying to locate susceptible crops, water-crossings and other sensitive areas. Appropriate "shut off" and "turn on" points should be marked so these areas can be avoided during the actual spraying operation.

ROADSIDE WEED CONTROL

The main objectives of a weed control program for roadsides are: (1) to control tall growing weeds so that mowing costs can be minimized; (2) to control weeds that may infest adjacent land by wind dispersal of seed; (3) to maintain an attractive grass cover that will minimize erosion problems; (4) to prevent buildup of excessive vegetation that can become a fire hazard in late summer or complicate snow removal in winter, and most importantly (5) to ensure highway safety for the travelling public. Most broadleaf weeds are susceptible to early summer applications of 2,4-D and related herbicides (Table 6). However, many weeds are not effectively controlled by 2,4-D mixtures and these resistant weeds can become an increasing problem unless other herbicides are used. The use of spot treatments with non-selective chemicals that may temporarily injure the grass may be justified in some cases to control isolated, but dense, patches of difficult weeds before they spread and become a problem over a large area.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Annual broadleaf weeds in newly constructed areas and biennial or perennial broad leaves, susceptible to 2,4-D	2,4-D*	1.1 kg/ha	Apply as the AMINE or LOW-VOLATILE ESTER in 200 to 300 L water per hectare in early summer. See Table 8 for weed susceptibilities for 2,4-D mixtures.

Most biennial and herbaceous perennial weeds	2,4-D/dichlorprop (1:1)**	2.25 to 3.25 kg/ha	Apply as the LOW-VOLATILE ESTER in 200 to 500 L water per hectare during early summer for most species.
	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L)	1.65 to 3.30 kg/ha 2.75 to 5.5 L/ha	Apply as the AMINE in 100 to 200 L water per hectare when weeds are actively growing.
	chlorsulfuron GLEAN (75 DF)	53 g/ha 70 g/ha	Addition of a surfactant may improve control.
Spot treatments for difficult weeds: Canada thistle, perennial sow-thistle	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L) dicamba (liquid) DYCLEER (480 g/L)	3.3 kg/ha 5.5 L/ha 1.1 kg/ha 2.3 L/ha	Apply sprays in late spring just prior to flowering, or apply to regrowth escaping other treatments in summer or fall.
	chlorsulfuron GLEAN (75 DF)	53 g/ha 70 g/ha	Addition of a surfactant may improve control.
	amitrole AMIZOL (90 SP) amitrole-t AMITROLE-T (240 g/L)	4.5 kg/ha 5 kg/ha 4.5 kg/ha 19 L/ha	Apply to the point of runoff when the thistles are in the head stage of growth. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 2000 to 300 L water per hectare when the thistles are in the bud to full flower stage. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season. See also, SELECTIVE WEED CONTROL WITH WIPER APPLICATORS section.
Leafy and cypress spurge	TBA TBA-4 GENERAL WEED KILLER (400 g/L)	10 to 20 kg/ha 25 to 50 L/ha	Apply in sufficient spray volume to thoroughly wet all foliage. Apply as a spot treatment only; grass cover may be removed for one season.
Leafy spurge	amitrole-t AMITROLE-T (240 g/L)	4.5 kg/ha 19 L/ha	Spray between advanced flowering and seedling stage. Treated areas should not be mowed but may be worked up after top growth is bleached.
Field bindweed	dicamba (liquid) DYCLEER (400 g/L) DYCLEER (480 g/L) dicamba/2,4-D DYCLEER 24 (600 g/L)	1.1 kg/ha 2.75 L/ha 2.3 L/ha 3.3 kg/ha 5.5 L/ha	Apply in mid-June or when flowering.
	2,4-D*	1.1 kg/ha	Apply in mid-June when flowering and repeat in early September.

ROADSIDE WEED CONTROL (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Field bindweed	amitrole AMIZOL (90 SP)	80 g/10 L 88 g/10 L	Apply sufficient spray to wet all foliage in early summer before flowering. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water per hectare when the field bindweed has reached full flower. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
Milkweed	amitrole AMIZOL (90 SP) amitrole-t AMITOLE-T (240 g/L)	80 g/10 L 88 g/10 L 80 g/10 L 0.33 L/10 L	Spray to wet in early summer before flowering. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water/ha to thoroughly wet all foliage when milkweed has at least reached the bud stage. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season. See also, SELECTIVE WEED CONTROL WITH WIPER APPLICATORS section.
Horsetail, toadflax, quackgrass	amitrole-t AMITROLE-T (240 g/L)	4.6 to 9 kg/ha 19 to 37 L/ha	Spray when horsetail is growing vigorously.
Goldenrod	dicamba DYCLEER (400 g/L) DYCLEER (480 g/L)	1.1 kg/ha 2.75 L/ha 2.3 L/ha	Apply when weed is actively growing in 100 to 200 L water/ha.

**The commercial formulations of 2,4-D are too numerous for specific mention in this publication.*
***There are several commercial formulations of 2,4-D/dichlorprop, see Table 1.*
While it is important to control weeds on roadsides, it is absolutely essential to take precautions to avoid damage to non-target vegetation adjacent to the roadside or right-of-way.

REDUCTION OF HERBICIDAL DRIFT

In the application of herbicides, especially of the hormone type (2,4-D, mecoprop, dichlorprop, dicamba, etc.), sensitive crops (grapes, tomatoes, turnips, tobacco, beans, carrots, beets, fruit trees, ornamental plants and many others) beyond the area being sprayed can be damaged by vapor drift or spray drift. To reduce the danger of herbicidal drift:

1. Use only amine formulations when it is necessary to apply phenoxy herbicides (2,4-D, mecoprop, dichlorprop, etc.) near sensitive non-target plants.
2. Very slight spray drift with herbicides containing dicamba can be more damaging to soybeans and other crops than equivalent amounts of 2,4-D spray drift. There is also a possibility of dicamba vapor drift from treated plant foliage during high temperatures (in excess of 25°C); thus, use of dicamba-containing herbicides should be avoided near sensitive desirable plants.
3. Use the lowest pressure possible to apply the herbicide. This may mean the use of a dribble bar, vibrajet nozzle, Directa-spra nozzle, flood jet, or more conventional nozzle tips.
4. Manufacturer's recommendations regarding nozzle spacing and height should be carefully followed. It may be necessary to mount nozzles on skids to keep them at a constant distance from the surface to be sprayed.
5. For roadside spraying, various spray additives, i.e. BIVERT PH, Norbak-60, or Nalco-Trol are available which may reduce spray drift by increasing the viscosity or density of the spray. These materials should be used following manufacturer's directions, and observing normal precautions (vehicle speed, wind velocity, proximity to sensitive crops, etc.).

WARNING: These methods and materials can reduce, but do not eliminate herbicidal drift. In areas near sensitive crops, all normal precautions must be taken. It should be emphasized that extremely low, even invisible, amounts of spray drift can be very damaging to sensitive crops. In some cases, spraying during the growing season should not be considered.

ROADSIDE GRASS RETARDATION (see TURF GRASS RETARDATION section)

WEED CONTROL IN DRY DITCHES

When ditches on roadsides, or in other locations, contain standing or moving water, herbicides should not be applied to emergent weeds without consulting the Ontario Ministry of the Environment regarding the need for a permit (see WATER WEEDS section). However, such permits are not normally necessary for the application of herbicides to control weeds adjacent to ditches or weeds in ditches when no water is present. But the following precautions should be taken:

1. Spray when ditch or stream contains little or no flowing water.
2. Avoid spraying directly onto water surface (violation of Pesticides Act, Water Resources Act).
3. Schedule spray programs so that extensive sections of stream bank or ditch bank are not sprayed at one time.
4. Work upstream rather than downstream along the stream bank or ditch bank.
5. Ascertain downstream water uses to avoid possible conflict with the rights of other landowners.

Cattails	amitrole AMIZOL (90 SP)	9 to 11 kg/ha 10 to 12 kg/ha	Apply when cattails are actively growing, in sufficient water (4000 L/ha or 50 L/100 m^2) to thoroughly wet all foliage.
	dalapon DOWPON M (74 SP) or BASFAPON (74 SP)	8 to 24 kg/ha 10 to 30 kg/ha 10 to 30 kg/ha	Apply in at least 1000 L of water per hectare after seed heads have formed.
	glyphosate ROUNDUP (356 g/L)	2.5 to 5 kg/ha 7 to 12 L/ha	Apply during mid- to late-flowering stage (mid-July to late August) when cattails are actively growing. For isolated spots use a 1% solution/1 L (product) in 100 L water and spray to wet all foliage, but not to the point of run-off.

WEED CONTROL IN DRY DITCHES (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Bulrushes	paraquat GRAMOXONE (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha	Apply in 750 to 1000 L water per hectare when the seed heads are forming — usually late July or August.
	2,4-D*	2.25 kg/ha	Apply as the LOW-VOLATILE ESTER in 750-1000 L of water per hectare.
Other weeds			See ROADSIDE WEED CONTROL section and Table 6 for the most effective treatments for species present.

**The commercial formulations of 2,4-D are too numerous for specific mention in this publication.*

SHORT-TERM TOTAL VEGETATION CONTROL

(Foliage Treatment Chemical Mowing)

Chemicals offer an alternative to mowing in areas where top-kill of low growing vegetation is desired. The chemicals listed below are first applied when the growth is about 15 cm high. Spray to runoff. Tall vegetation is more difficult to kill and can become an unsightly fire hazard when it dies.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Control of any emerged annual or perennial weeds	amitrole AMIZOL (90 SP) amitrole-t AMITROLE-T (240 g/L)	4.5 to 6.5 kg/ha 5 to 7 kg/ha 4 kg/ha 17 L/ha	Amitrole, Amitrole-T, or glyphosate must be applied to actively growing foliage to be effective. Apply in sufficient water (200 to 400 L/ha) to thoroughly wet all foliage. With amitrole or amitrole-t, newly formed leaves turn white before the plants die. The appearance of foliage injury may be delayed during cool conditions. Regrowth may occur from freshly germinating plants or from underground portions of perennial weeds. See also, SELECTIVE WEED CONTROL WITH WIPER APPLICATORS section.
	glyphosate ROUNDUP (356 g/L)	1.8 to 2.5 kg/ha 5 to 7 L/ha	
Top-kill only of annual or perennial plants	paraquat GRAMOXONE (200 g/L) diquat REGLONE (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha 1.1 to 2.2 kg/ha 5.5 to 11 L/ha	Diquat or paraquat should be used at the higher rates and in a high spray volume (1000 L/ha) for dense weed growth. For chemical mowing along roadsides and other areas where a scorch is desired, paraquat at 0.55 L/ha will be adequate.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	70 kg/ha 140 L/ha	Apply in approximately 1000 L water per hectare. Thoroughly wet all foliage. Ammonium sulfamate is **corrosive** to metal, thus it is essential to thoroughly clean spray equipment after use.

LONG-TERM TOTAL VEGETATION CONTROL

(Bare Areas — Soil Sterilization)

It may be desirable to maintain certain areas completely free of vegetation. Usually two problems are involved. First, the existing vegetation must be destroyed, including the destruction of underground stems and roots of perennials. Second, the bare area thus produced must be maintained either by long-term soil sterilization or by foliage treatment of weed seedlings.

Some soil sterilants will kill existing vegetation. Others, while excellent for maintaining the bare area, may be used more economically if combined with another chemical to kill existing growth. If a mixed population of weeds is present, combinations of chemicals that will kill the different types may be used advantageously.

Uniform coverage with all chemicals is essential. Touch-up operations should be expected, as a single treatment will seldom give complete eradication.

It is usually found that two applications of the lower recommended rate, i.e., 5.5 to 11 kg per hectare, depending on the chemical used, spaced 6 to 12 months apart, give better results than one single application of the higher recommended rate.

The length of weed control obtained with soil sterilants will depend on several factors which include rainfall, soil type, weed type and amount applied. Control is usually maintained longer in heavier soil types, while in sandy soils and gravel areas the length of effective control is much less.

Care should be exercised when selecting a chemical to use on driveways because washing of the chemical onto nearby lawns and gardens may occur. In situations where this may occur it is advisable to use one of the chemicals listed under "SHORT-TERM TOTAL VEGETATION CONTROL," or "DRIVEWAYS AND PATIOS."

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Non-selective control of all vegetation	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	200 to 250 g/5 L water 400 to 500 g/5 L water	
	amitrole/simazine AMIZINE (159 g/L)	12.84 kg/ha 80 L/ha	
	bromacil HYVAR X (80 WP) or HYVAR XL (240 g/L)	5.5 to 11 kg/ha 7.7 to 13.5 kg/ha 30 to 45 L/ha	Mullein is not adequately controlled by bromacil.
	bromacil/diuron (1:1) KROVAR (80 WP)	10 to 15 kg/ha 14 to 18 kg/ha	
	diuron KARMEX (80 WP)	11 to 44 kg/ha 14 to 55 kg/ha	Plantain is not adequately controlled by diuron.
	hexazinone VELPAR (90 SP)	4 to 8 kg/ha 4.5 to 9.0 kg/ha	

LONG-TERM TOTAL VEGETATION CONTROL (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Non-selective control of all vegetation	simazine SIMMAPRIM NINE-T (90 SG) SIMADEX (500 g/L)	11 to 22 kg/ha 12.5 to 25 kg/ha 22 to 44 L/ha	Crabgrass as well as triazine-resistant biotypes of other weeds are not adequately controlled on atrazine-treated sites.
	atrazine PRIMATOL NINE-O (90 SG)	11 to 22 kg/ha 12.5 to 25 kg/ha	Crabgrass as well as triazine-resistant biotypes of other weeds are not adequately controlled on simazine-treated sites.
	bromacil/2,4-D CALMIX	20 to 40 kg/ha 250 to 500 kg/ha	Use higher rate for the more dense infestations of weeds.
Non-selective control of all vegetation	tebuthiuron SPIKE (80 WP) SPIKE (5% G)	4.4 to 11 kg/ha 5.5 to 13 kg/ha 110 to 220 kg/ha	Field horsetail is not adequately controlled by tebuthiuron.

CAUTION: The above chemicals should not be used to treat areas that are close to gardens, desirable trees, etc. Since these chemicals will kill any plant that they contact, special care for forethought must be used in their application. If the area (for example, a driveway) is higher than a nearby lawn, the chemical may wash onto the lawn with the first rain. If trees or shrubs are feeding under the treated area, the chemical may leach to their roots and cause injury.

PERENNIAL WEED CONTROL (NON-CROPLAND)

Perennial weeds are more difficult to control than annual weeds because regrowth occurs rapidly from underground parts after the top growth is removed by chemical or mechanical means. In non-crop land they pose a special problem because cultivation cannot be used for their control. Chemicals must kill the root system as well as the above-ground parts to give effective perennial weed control.

All perennials, non-selective control	diuron KARMEX (80 WP)	11 to 44 kg/ha 14 to 55 kg/ha	Apply in 1000 L water per ha.
	simazine SIMMAPRIM NINE-T (90 SG) SIMADEX (500 g/L)	11 to 22 kg/ha 12.5 to 25 kg/ha 22 to 44 L/ha	Apply as a coarse spray. Follow the manufacturer's directions regarding agitation.

	atrazine PRIMATOL [illegible]NE-O (90 SG)	11 to 22 kg/ha 12.5 to 25 kg/ha	Apply as a coarse spray. Follow the manufacturer's directions regarding agitation.
	bromacil HYVAR XL (240 g/L) or HYVAR X (80 WP)	7.2 to 11 kg/ha 30 to 45 L/ha 9 to 14 kg/ha	
	amitrole/simazine AMIZINE (60 WP)	14 kg/ha 23 kg/ha	Apply in 110 L water per hectare when weeds are actively growing.
	bromacil + diuron (1:1) KROVAR (80 WP)	11 to 15 kg/ha 14 to 18 kg/ha	
	chlorsulfuron GLEAN (75 DF)	90 g/ha 120 g/ha	Addition of a surfactant may improve control. Follow manufacturer's directions.
2,4-D-susceptible weeds	2,4-D*	1.1 to 1.8 kg/ha	See Table 8 for list of weed susceptibilities to 2,4-D and related chemicals.
Evergreens and brush (less than 1.5 m)			See sections on BRUSH CONTROL and EVERGREENS AND CONIFER CONTROL for susceptibility of woody species to 2,4-D and related compounds.
Canada thistle or perennial sow-thistle	dicamba/2,4-D (1 to 2) DYCLEER 24 (600 g/L) dicamba (liquid) BANVEL (480 g/L)	3.3 kg/ha 5.5 L/ha 1.2 kg/ha 2.3 L/ha	Apply spray in late spring just prior to flowering, or apply to regrowth escaping other treatments, in summer or fall. Granules should be applied uniformly when plants are actively growing.
	amitrole AMIZOL (90 SP)	1.6 kg/ha 1.8 kg/ha	
	amitrole-t AMITROLE-T (240 g/L)	1.6 kg/ha 6.7 L/ha	
Leafy and cypress spurge, field bindweed	TBA TBA-4 GENERAL WEED KILLER (400 g/L)	11 to 22 kg/ha 27 to 55 L/ha	Don't apply near valuable trees or shrubs. Active soil residues may last more than one year.
Field bindweed, milkweed, Canada thistle and common tansy	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water per hectare when field bindweed has reached full flower, and Canada thistle and milkweed have reached the bud to bloom stage.

PERENNIAL WEED CONTROL (NON-CROPLAND) (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Field bindweed	dicamba/2,4-D DYCLEER 24 (600 g/L)	3.3 kg/ha 5.5 L/ha	Apply sprays in mid-June or when flowering, in 100 to 200 L water per hectare.
	dicamba (liquid) BANVEL (400 g/L) BANVEL (480 g/L)	1.1 kg/ha 3.0 L/ha 2.3 L/ha	Granules should be applied uniformly when plants are actively growing.
Milkweed	amitrole AMIZOL (90 SP)	4.5 kg/ha 5 L/ha	Apply in 500 to 1000 L water per hectare before flowering.
	amitrole-t AMITROLE-T (240 g/L)	4.5 kg/ha 19 L/ha	Apply in 1000 L water per hectare.
Goldenrod	2,4-D mixtures*	1 to 2 kg/ha	Apply in 1000 L water per hectare.
	dicamba/2,4-D DYCLEER 24 (600 g/L) dicamba BANVEL (400 g/L) or BANVEL (480 g/L)	3.3 L/ha 5.5 L/ha 1.1 kg/ha 2.75 L/ha 2.3 L/ha	Apply when weed is actively growing, in 100 to 200 L water/ha.
Quackgrass and other creeping perennial grasses	amitrole AMIZOL (90 SP)	4.5 to 6.75 kg/ha 5 to 7 kg/ha	Apply to actively growing quackgrass foliage. Wait at least 10 days before plowing or disking. With amitrole or amitrole-t, most field crops can be planted safely 2 to 3 weeks after applying the chemical.
	amitrole-t AMITROLE-T (240 g/L)	4 kg/ha 17 L/ha	
	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.8 to 7 L/ha	Apply in 200 to 300 L water per hectare when quackgrass is actively growing and has 3 to 4 new leaves on each shoot. Wait at least 5 days before mowing or working the area.
	dalapon DOWPON M (74 WP) or BASFAPON (74 WP)	8.5 to 12.5 kg/ha 11 to 16 kg/ha or 11 to 16 kg/ha	Apply to actively growing quackgrass foliage. Wait at least 5 days before mowing or working the area. Dalapon will remain toxic to most crops for 4 to 5 weeks after application — possibly longer during cold or dry weather.
	propyzamide KERB (50 WP)	1.1 to 1.8 kg/ha 2.2 to 3.6 kg/ha	Apply in fall from late September to early November but before soil freezes. Control of weeds other than perennial grasses cannot be expected.

Canada thistle, dandelion, or field horsetail	chlorsulfuron GLEAN (75 DF)	90 g/ha 120 g/ha	Addition of a surfactant may improve control. Follow manufacturer's directions. Grasses may also be injured.
Perennial weeds in pastures	See PASTURES.		

**Numerous commercial formulations are available.*

WARNING: Unless otherwise recommended, the above treatments should not be used in crop situations. Their use should also be avoided if the chemical is likely to wash or leach into areas occupied by the roots of desirable trees or other plants. Precautions should also be followed to avoid spray drift onto non-target vegetation.

The use of atrazine, simazine, bromacil, or diuron non-selectivity, as described above, is generally limited by cost to the handling of small patches of perennial weeds. The chemical either leaches down to the weed-root system, or makes the surface soil toxic for a period of time, varying from a few months to several years, depending on the chemical, rate of application, and soil type. Generally, crops cannot be grown successfully until the effect of the chemical has disappeared. Corn, however, can be grown safely when high rates of simazine and atrazine are applied.

Some perennial weeds, such as field bindweed, horsetail, goldenrod, milkweed and bracken fern, are difficult to eradicate at the lower rates of diuron, simazine, atrazine, and bromacil.

Follow the manufacturer's directions carefully if the area is to be re-seeded. Both the dalapon and amitrole treatments are of value in spot-treating patches of quackgrass in a field that is not entirely infested.

While the tops of many perennial weeds may be controlled by doses of 2,4-D that may be selectively used in resistant crops, heavier doses, as described above, must be used if eradication is to be attempted. Several applications upon successive stages of regrowth will probably be necessary. Generally, treatments with 2,4-D during rapid development of the weed, at about the early bud to flowering stages of growth, are most effective. Spray should be applied to thoroughly wet all foliage.

Heavier doses of 2,4-D on patches of weeds may be applied during normal selective spraying operations merely by slowing down the sprayer speed in the infested areas. Local crop damage should be expected where this is done.

POISON-IVY CONTROL

Several chemicals have been shown to be effective for the control of poison-ivy. However, some growth may occur after treatment with any of these chemicals and re-treatments will be necessary to achieve eradication. The chemical treatment for poison-ivy must take into account the location in which the weed is growing. If desirable shrubs or trees are present, the soil sterilants should be avoided, and the other materials used with caution.

Poison-ivy	amitrole AMIZOL (90 SP)	3.24 kg/ha 3.6 kg/ha	Apply in at least 1000 L water per hectare when plants are actively growing. Thoroughly wet all foliage.
	amitrole-t AMITROLE-T (240 g/L)	4 kg/ha 17 L/ha	Apply in at least 1000 L water per hectare when plants are actively growing. Throughly wet all foliage.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	200 to 250 g in 5 L water 400 to 500 g in 5 L water	Thoroughly wet all foliage.
	2,4-D/dichlorprop* (1:1)	2.25 kg/ha	Apply in sufficient volume of water to thoroughly wet all foliage.
	borate compounds	2 to 3 kg/10 m^2	Follow manufacturer's directions on the label.

POISON-IVY CONTROL (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Poison-ivy	2,4-D/mecoprop/ dicamba**	1.1/0.55/0.1 kg/ha	Apply in at least 100 L water per hectare.
	dicamba/2,4-D (1:2)*** DYCLEER 24 (600 g/L)	0.85 to 1.7 kg/ha 1.4 to 2.9 L/ha	Apply in at least 560 L water per hectare.
	glyphosate ROUNDUP (356 g/L)	2.50 to 4.25 kg/ha 7 to 12 L/ha or 50 mL per 5 L water	Apply to actively growing plants in 200 to 300 L water per hectare to thoroughly wet the foliage, but do not spray to the point of run-off.

**Numerous commercial formulations are available, see Table 1.*
***Number of commercial formulations is too numerous for specific mention.*
****Tank mixes of various individual 2,4-D and dicamba products are also possible.*

A 9 to 14 L sprayer is the most convenient method of applying herbicides to patches of poison-ivy. Thorough coverage of the leaves with the spray is essential for maximum effect. After spraying, the area should be left alone until the plants die, when the dead stems should be gathered up and buried. Even at this stage care should be taken as poisoning may be brought about by handling the dead plant. All treatments are most effective when the poison-ivy is in full leaf and growing actively, from about June 15 to July 31.

BRUSH CONTROL

There are several techniques that may be used for the chemical control of deciduous woody species: stem foliage sprays, basal bark sprays, frilling or spot treatments. The choice of technique will depend on such factors as brush type, accessibility, availability of equipment, proximity to susceptible crops or ornamental vegetation, and the size of the control program.

Stem Foliage Treatments with Water as a Carrier

Stem foliage treatment of brush should be limited to smaller growth (less than 2 m in height). Treatments should be applied to thoroughly wet the stems and foliage to the point of run-off. This technique is most effective just after full leaf development in late spring or early summer.

The choice of chemicals for controlling stands of deciduous brush should be based on the susceptibilities of the predominant species (Table 6), or whether the brush to be controlled is near homes, recreational areas, etc.

Most deciduous woody species	2,4-D*	3 to 6 kg/1000 L	One application may be sufficient for sensitive species. For intermediately sensitive species, repeated treatments are normally required.
	2,4-D/dichlorprop** (1:1)	5 to 6 kg/1000 L	Apply as the LOW-VOLATILE ESTER, in areas dominated by species expected to be tolerant to 2,4-D alone.

	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L) dicamba + 2,4-D DYCLEER (480 g/L) + 2,4-D (500 g/L)	6 kg/1000 L 10 L/1000 L 2 kg + 4 kg/1000 L 4.2 L + 8 L/1000 L	Apply to the point of run-off when the leaves are fully expanded.
White ash, sugar maple	dicamba + (2,4-D + dichlorprop)	2.5 + (2.5 + 2.5) kg/1000 L Tank-mix	Follow instructions on DYCLEER label and prepare as a tank-mix. Apply to the point of run-off when leaves are fully expanded.
Oak, maple, alder, hickory and ash	fosamine ammonium KRENITE (480 g/L)	5 to 7 kg/1000 L 10 to 15 L/1000 L	Additional surfactants may be required for difficult species. Follow manufacturer's directions.
Non-selective control, most woody and herbaceous species	glyphosate ROUNDUP (356 g/L)	3.5 to 5 kg/1000 L 10 to 14 L/1000 L	Can be applied during June, July or August.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	200 to 250 g/5 L 400 to 500 g/5 L	Thoroughly wet all foliage.

**The commercial formulations containing 2,4-D are too numerous for specific mention in this publication.*
***There are numerous commercial formulations containing 2,4-D and dichlorprop, see Table 1.*

Basal-Bark Treatments in Oil as a Carrier

The BASAL-BARK treatment is useful on a wide range of trees and brush with a trunk diameter up to about 15 cm. The chemical is applied so as to thoroughly cover the basal 30 cm of the trunk and any exposed roots. For oak, hickory, basswood, or ash, treatments are most effective from February to June. Most other species may be treated at any season of the year.

Light, simple equipment, coupled with the possibility of winter operations, when labor is cheaper and access to swampy areas possible, give this treatment an important role in a brush control program.

Most woody species, including conifers	2,4-D/dichlorprop* (1:1)	2 kg/100 L	Use the LOW-VOLATILE ESTER formulations in fuel oil.
Hawthorn	2,4-D**	3 kg/100 L	Use the LOW-VOLATILE ESTER formulations in fuel oil.

**See Table 1 for the numerous commercial formulations that are available.*
***Commercial formulations containing 2,4-D are too numerous to mention.*

Stump Treatment After Cutting

In many cases it it more desirable to remove existing brush by hand than to kill it by spraying and leave the dead material standing. The stump treatment is particularly useful in preventing the vigorous regrowth that is the characteristic response of many deciduous species after the cutting. Moreover, killing the stump is the first step towards encouraging it to rot.

All of the treatments must be applied to freshly exposed wood. They may be applied at any season of the year, preferably right after the tree or brush is cut. If, however, an old stump is to be killed, it should be split with a wedge, or have holes drilled into it, so that fresh wood should be exposed to the chemical. Regrowth from an old stump should be treated as well as the stump proper.

Most species can be controlled with 2,4-D as the LOW-VOLATILE ESTER at a concentration of 2 kg (acid) per 100 L fuel oil. This treatment can be applied as a spray or paint.

If spray is used, all surfaces of the stump should be treated. Various dye (Dupont Rhodamine Red) materials may be added to the herbicide to facilitate keeping track of sprayed stumps.

EVERGREEN OR CONIFER CONTROL

Stem-Foliage Treatments with Water as a Carrier

All of the treatments are applied so as to **thoroughly** wet all foliage. Use low pressure and apply from 500 to 1500 L solution per hectare, depending on the amount of foliage. The TCA treatments of evergreens, applied during the growing season, will control balsam, spruce, and pine. Thorough coverage is particularly important, and the addition of a wetting agent will increase effectiveness. TBA (TRICHLOROBENZOIC ACID) is also effective on evergreens. It may be applied alone, or with ammonium sulfamate.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Spruce, balsam, pine	TCA SODIUM-TCA (79 G) NaTA (85 WP)	10 to 14 kg/1000 L 13 to 17 kg/1000 L 20 to 25 kg/1000 L	Follow manufacturer's directions on the label.
	TBA	3 kg/1000 L	Follow manufacturer's directions on the label.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	3 kg/100 L 6 kg/100 L	Follow manufacturer's directions on the label.
	paraquat GRAMOXONE (200 g/L)	1 kg/1000 L 5 L/1000 L	Apply in spring or early summer. Thorough coverage is needed.
Mixed stands (conifers and deciduous brush).			The above treatments can be combined with 2,4-D, dichlorprop treatments that are recommended for the species of deciduous brush present (Table 6).
	dicamba/2,4-D DYCLEER 24 (600 g/L) dicamba + 2,4-D DYCLEER (480 g/L) + 2,4-D (500 g/L)	2 + 4 kg/1000 L 10 L/1000 L 2 kg + 4 kg/1000 L 4.2 L + 8 L/1000 L	Apply as AMINES in early summer. Thorough coverage is needed. Granules should be applied in spring when rain can be expected.

dicamba + (2,4-D + dichlorprop)	2.5 + (2.5 + 2.5) kg/1000 L Tank-mix	Apply in spring or early summer. Thorough coverage is needed. Follow instructions on Dycleer label for tank-mix.

GENERAL TREATMENTS FOR WOODY SPECIES

Soil Treatment

Single or scattered trees or shrubs may be controlled efficiently with dry applications of sodium borate, chlorate mixtures, or ammonium sulfamate (WILSON'S POISON-IVY and BRUSH-KILLER). Apply the chemical in a band at the base of the plant, following the manufacturer's directions.

Basal (Spot) Treatment

On stands of deciduous or coniferous brush that range from light to scattered, use individual spot treatment with bromacil (HYVAR X-L). It may be applied with an exact delivery hand-gun. Apply undiluted at 10 g per metre of height (5 cm diameter) or brush or dilute 1 L HYVAR X-L with 5 L of water and apply 60 g per metre of height of brush. Taller and larger brush requires progressively more herbicide.

Tebuthiuron (SPIKE 80 WP) may also be used as a spot treatment to control standing or cut brush in non-crop land or non-landscaped areas. Apply 2 g active tebuthiuron to stumps or trunks less than 5 cm in diameter. For larger stumps or trunks, apply an additional 2 g tebuthiruon on opposite side of stem. With a mixture of 125 g product (SPIKE 80 WP) per litre a properly calibrated spot gun or back-pack sprayer can be employed to deliver 20 ml or 40 ml per tree, respectively, to apply the proper rates of active ingredient described above. See manufacturer's label for applications instructions and precautions.

Sucker Growth Control After Pruning

Many trees sprout prolifically after they have been pruned. The application of fortified tree-wound dressings to the surface of the cuts can reduce the number of new sprouts from many tree species.

These paints improve natural inhibition achieved through the use of poor trimming practice. All pruning should be done to strong laterals. Severe pruning should be avoided.

Best results will be obtained if the materials are applied to the cuts between April 15 and July 15. Treatment of all cuts is important, as each is a potential location for sprouting from both dormant and adventitious buds. Cover the entire cut and about 2 cm of the surrounding bark, especially below the cut. Heavy tree-wound dressing will adversely affect rate of callus formation of some species.

Alpha naphthalene acetic acid, ethyl ester (TREHOLD), as a 1% surface tree-wound dressing or aerosol, can be effective on willow, poplar, maple, oak, elm, basswood, apple and possibly other species.

TABLE 6. SUSCEPTIBILITY OF WOODY PLANTS TO FOLIAGE SPRAYS OF 2,4-D, 2,4-D MIXTURES and AMMONIUM SULFAMATE

Common Name	2,4-D	2,4-D Dichlorprop (1:1)	2,4-D Dicamba (2:1)	Ammonium sulfamate	Fosamine ammonium
alder	S-I	S	S		S
arborvitae	R	R	S	S-I	
ash	R	S-I	I-R		S-I
barberry, common	I	S			S
basswood	R	S	S		S
beech	R		I	S-I	S-I
birch	S	S	S	S	
blackberry	R		I-R	I-S	S
blueberry	S	S	I-R	I	I
buckthorn	I-R		I-R	I	
cedar	R	I-R	S	S-I	
cherry, black, red	S-I	S	S	S	S-I
cherry, choke	S-I	S	S	S	S
cranberry	S				
creeper, Virginia	S	S-I	S	R	S-I
currants, wild	R		S	I	
dogwood	S-I	S		S-I	S
elderberry	S		S-I	S	
elm	I	S-I	S	S-I	S-I
fir, balsam	R	S-I	S	S-I	
grape, wild	S	S	S		
hardhack, spiraea	I			I	
hawthorn	I-R	S	I-S	I	S
hemlock	R			S-I	
hickory, black, shagbark	R	S-I	S	S-I	I
honeysuckle	S-I	S	S	S	
ironwood	R	S-I	S	I	
juniper	R	I-R	S	I-R	
lilac	I-R			I	
locust, black	I			I	
locust, honey	S-I			I	
maple, Manitoba	S-I	S	S	S-I	S-I
maple, red	R	I-R	I-R	S-I	S-I
silver	S-I			S	
sugar	R	S-I	I-R	S-I	
oak, red	I	I-R	S	S	I-R
white	I	S-I	S-I	S	
bur	R-I		S		I-R
pine	R	S-I	S	S	I-R
plum, wild	I	S			S
poison-ivy	I	S-I	S	S	I
poplar, aspen	S	S	S	I	
prickly-ash	R		S		S
raspberry, wild	R	S	I	I-S	S
redbud rhododendron	R			R	

TABLE 6. SUSCEPTIBILITY OF WOODY PLANTS TO FOLIAGE SPRAYS OF 2,4-D, 2,4-D MIXTURES and AMMONIUM SULFAMATE (cont'd)

Common Name	2,4-D	2,4-D Dichlorprop (1:1)	2,4-D Dicamba (2:1)	Ammonium sulfamate	Fosamine ammonium
rose, wild	R	I	S		S
sassafras	S-I			I-S	
sheep-laurel	I		S		
spruce	R	I-R	S		
sumac, poison	S				
sweet-fern	I		S	S-I	S-I
viburnum	R			I	
walnut	S-I			S	
willow	S	S	S	S	S

S *Susceptible. Adequate control obtained with one application.*
I *Intermediate. Re-treatment is usually needed for adequate control.*
R *Resistant. Two or more applications may not be adequate.*

Handy Metrics Conversion Factor

Litres per hectare x 0.4 = litres per acre
Kilograms per hectare x 0.4 = kilograms per acre

WATER WEEDS (AQUATIC PLANTS)

A permit is usually necessary for the application of herbicides, or other pesticides, to water or a water-course. However, no permit is required by the owner to treat a pond which is entirely within his property and has no outflow; or by a person to treat a drainage ditch which is considered dry (contains water 50% or less of the year).

Purchase of certain compounds for treating enclosed ponds requires authorization (these include simazine, CUTRINE PLUS, ALGIMYCIN PLL-C, REGLONE A, AQUA-KLEEN, and GRAMOXONE) from the Ministry of the Environment.

For further information on licensing and permits, contact any Ministry of the Environment Regional Office or Ministry of the Environment, Commercial and Agricultural Chemicals Section, 135 St. Clair Avenue West, Toronto, Ontario, M4V 1P5, Telephone: (416) 965-2401.

ALGAE AND VACULAR SUBMERGENTS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Filamentous algae, pond scums	copper compound	0.175 to 0.35 kg/ 1000 m^3 of water	Not for use in public waters or waters during draining into public waters. Not for use in potable waters. To be applied to areas where algae is well-established and growing vigourously. Do not apply in deep water.
	SLOW RELEASE ALGIMYCIN PLL-C (5% PE)	3.5 to 7 kg/1000 m^3 (1,000,000 L) of water	
	copper compound	0.15 L/1000 m^3 0.3 to 0.45 L/1000 m^3	Treat 1/3 of a pound at a time to avoid oxygen depletion. Wait 72 hours before treating the next section. Care must be taken where fish are present.
	LIQUID ALGIMYCIN PLL-C (5% SN)	3 L/1000 m^3 (1,000,000 L) of water, dilute about 1 to 4 with water	
	copper compound CUTRINE PLUS (9.0% Li)	0.83 L/ha; 2.5 L/ha If an average water depth is 0.5 m use 9.21 L/ha; if 1.5 m use 27.63 L/ha. Dilute these at 1 to 9 before applying.	Used only in water where there is no flow from the property. Not for use in potable waters. No restrictions on swimming or fishing. Care should be taken if fish are present.

Filamentous algae, pond scums	simazine SIMMAPRIM NINE-T (90 SG)	4.5 g/10,000 L of water (no flow) or 9 g/10,000 L of water (minimal flow) 5 g/10,000 L of water (0.5 g/m^3 of water), where there is no flowthrough or 10 g/10,000 L of water (1.0 g/m^3 of water), where flow is minimal	Water from treated ponds is not to be used for irrigation or human consumption. Fish taken from treated ponds not to be used for human consumption. Treat early before dense growth starts. To avoid oxygen depletion later in season treat the pond in sections.
Submerged plant-like algae: Chara and Nitella spp, in ponds	copper compound SLOW RELEASE ALGIMYCIN PLL-C (5% PE)	1.1 kg to 2.3 kg/ha 22.5 kg to 45 kg/ha	Use the lower rate if treated when the vegetation is young and actively growing. Higher rates to be used later in the season as plants become more resistant.
	copper compound CUTRINE PLUS (9% Li)	1.7 L/ha; 5.0 L/ha If average water depth is 0.5 m use 18.42 L/ha; if 1.5 m use 55.26 L/ha — dilute these at 9 to 1 before applying.	In hard water CUTRINE PLUS is toxic to fish if 0.4 ppm is exceeded. If fish are present but water hardness is not known, do not use CUTRINE PLUS.
	simazine SIMMAPRIM NINE-T (90 SG)	18 g/10,000 L 29.3 g/10,000 L 20 g/10,000 L of water to 32.5 g/10,000 L of water (2 to 3.25 g/m^3 of water)	Use the higher rate when heavy infestations occur. Do not use treated water for irrigation or human consumption. Do not use fish taken from treated water for human consumption.
Emerged and submerged rooted aquatic plants	simazine SIMMAPRIM NINE-T (90 SG)	22.5 kg in 500-2200 L of water/ha or 248 g in 5 to 15 L of water/100 m^2 25 kg in 500-2200 L of water/hectare or 275 g in 5 to 15 L of water/100 m^2	"Drawdown treatment" — application should be made to exposed soil or mud when water level is lowered. Apply in the fall before freeze-up or as early in the spring as possible. Do not raise water level until sufficient rainfall has occurred to carry the chemical into the soil. Also for beach areas above the water line. Apply in fall well before freeze-up or as early in spring as conditions permit. Discing after application will assist in controlling deeper rooted weeds.

ALGEA AND VASCULAR SUBMERGENTS (cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS (For more information, see "Notes on Chemicals" section.)
Emerged and submerged rooted aquatic weeds	simazine SIMMAPRIM NINE-T (90 SG)	9 g/10,000 L 10 g/10,000 L of water or 1 g/m^3 of water	Water flow to be shut off and remain so for 10 days after treatment. Do not use treated water for irrigation or human consumption. Fish taken from treated ponds should not be used for human consumption.
Mixed submerged aquatics in ponds	diquat REGLONE A (200 g/L Sn)	4.4 kg/L/ha; 6 kg to 7 kg/L/ha 22 L/ha in 1.5 m or less: use 30 to 35 L/ha if greater than 1.5 m	Do not use treated water for consumption or swimming for 24 hours. Do not use for irrigation for 5 days. To avoid oxygen depletion treat only 1/4 to 1/3 of the area at a time. Apply at dusk in mid-to-late June when plants are young and growing vigorously. Tape grass and Chara are NOT controlled.
	2,4-D low-volatile ester AQUAKLEEN (20% GR)	22 to 45 kg/ha 110 to 225 kg/ha	Treat in spring or early summer when weeds are starting to grow. When weed mats are dense and water is over 2 meters use the higher rate. Read label carefully regarding restrictions on use of treated waters. Tape grass and Chara are NOT controlled.
Eurasian water milfoil in lakes	diquat REGLONE A (200 g/L)	2.2 kg/ha of water surface 11 L/ha of water surface	Treat when plants are in the very early stage of growth (June).
	2,4-D low-volatile ester AQUAKLEEN (20% GR)	22 to 45 kg/ha 110 to 225 kg/ha	Treat in spring and early summer when plants are starting to grow. Read label for restrictions on treated water use.

Emergents

Arrowhead, water plantain, pickerel weed, wild rice, cattails, bulrushes in swamps and drainage ditches	paraquat GRAMAXONE (200 g/L)	1.1 kg to 2.2 kg in 850 to 1000 L of water/ha 5.5 to 11 L in 850 to 1000 L of water/ha to be treated	Do not use treated water for 7 days for swimming, human or animal consumption. Do not use for irrigation for 5 days. Do not apply to muddy water or agitate water excessively for 1-2 days after treatment.
	amitrole AMINO AMIZOL (50% SP)	9 to 11 kg in 3000 to 4000 L of water/ha 18 to 22 kg in 3000 to 4000 L of water/ha[2]	To control cattails in marshes and drainage ditches. Apply after cattails are 0.5 to 1.0 m in height but before frost. Do not apply where water will be used for irrigation, drinking or other domestic purposes. Apply late afternoon or evening.

Arrowhead, water plantain, pickerel weed, wild rice, cattails, bulrushes in swamps and drainage ditches	dalapon	20.4 to 33.3 kg/ha in 450 L of water 7.4 to 14.8 kg/ha in 1000 L of water	Apply 7 days before killing frost. Spray after sprouts have emerged and are 0.5 to 1.0 metres tall. For use only in drainage and irrigation ditches.
	DOWPON M (74% WP)	27.5 to 45 kg/ha in 450 L of water	
	BASFAPON (74% WP)	(spray boom) 10 to 20 kg in 1000 L of water (orchard-type spray gun)	
Water lilies	2,4-D low-volatile ester	35 to 45 kg/ha	Repeat treatment for yellow water lily or spatterdock may be necessary. Treat in mid-summer.
	AQUAKLEEN (20% GR)	175 to 225 kg/ha of water surface	
Duckweed	diquat	2.2 kg/ha of water surface	Apply by directed surface spray on foliage. Use 1 part REGLONE A with at least 4 parts of clean water.
	REGLONE A (200 g/L)	11 L/ha of water surface	

The use of herbicides may be complicated by the use of water by livestock or humans or by the presence of fish. If the water is flowing, the effect of the chemical on plant, animal, or fish life down stream must be considered. Flowing water, by diluting the herbicide, makes control less effective. The vegetation also varies widely: including completely submerged ones such as *Elodea* (Canada waterweed) and algae; free-floating ones such as duckweed; anchored-floating ones such as water-lilies, and emergent plants. Many of these will grow equally well on the moist shoreline as when their lower stems and roots are in water. Where these emergent species have taken possession of the shoreline, control measures must embrace that area as well as the water.

Simazine can provide a season's control of algae in ponds having a minimum flow-through. Simazine should not be applied to ponds used for irrigation.

Chara (Stonewort, muskgrass) is a gray-green to green plant-like algae, attached to the sediment, which in dense communities has a very strong musk odor. It is brittle to the touch and will dry to a white powder upon removal from the water. This plant is difficult to control with moderate doses of algicides and dense communities should be removed mechanically.

Tape-grass (wild celery) (Vallisneria americana) found in many recreational lakes, is resistant to all the currently recommended herbicides. It has long rubber-like leaves and numerous short roots. Control must be confined to mechanical methods such as pulling.

Diquat provides good control of a wide variety of submergent species including water-milfoil, pondweeds, Elodea (Canada waterweed) and coontail. This herbicide is not effective against muskgrass (Chara spp). Diquat should be applied on cloudy days in later afternoon and care should be taken not to stir up the bottom since turbidity reduces the effectiveness of treatment. Since diquat takes effect rapidly, decomposition of a large plant mass may cause oxygen depletion problems which can cause fish to suffocate. Thus, in ponds where fish are present and growth is well established, half of the pond should be treated at one time and the other about two weeks later. The best time to apply these chemicals is late spring while the plants are growing rapidly. Since this is a contact chemical, control is achieved for one season, and repeat treatments must be made annually.

2,4-D ester (AQUAKLEEN) consists of specially formed and hardened 2,4-D granules which sink rapidly to the bottom of lakes or ponds where release of chemical takes place. Muskgrass and tape-grass are not controlled. Since this herbicide is systemic in action, collapse of the plant community may take 2 or 3 weeks. Treat in spring when growth is young (60 to 90 cm long). Apply as described above when large areas are treated. Control achieved is for one season.

For control of waterlilies apply AQUAKLEEN in mid-July to early August, after plants have flowered. At least two successive treatments (one per year) will be required.

Emergent species such as cattails and bulrushes may have to be sprayed for 2 or 3 consecutive years to bring them under complete control. The chemicals for cattails and other emergents are sprayed so as to thoroughly wet all exposed foliage. Paraquat and amitrole are most effective when cattails are coming into head. Dalapon should be applied using an orchard-type gun. Consult manufacturer's directions.

Additional information may be obtained by contacting the Ministry of the Environment, Commercial and Agricultural Chemicals Section, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, Telephone: (416) 965-2401.

TABLE 7. HABITATS AND HERBICIDE SUSCEPTIBILITY OF COMMON AQUATIC PLANTS

	A	B	C	D	E	F		1	2	3	4	5	6
	Spring-fed Pond	Dugout	Soft Water Lake*	Hard Water Lake**	Wet Ditch***	Dry Ditch****							
ALGAE													
Spirogyra sp.	VC	VC	C-I		VC	I		S	S	R	R		
Ulothrix sp.	C	VC			VC			S	S	R	R		
Mougeotia sp.	C	VC			VC			S	S	R	R		
Cladophora sp.	VC	VC	C	VC	VC			S	S	R	R		
Chara sp. (Muskgrass)	VC	I	C-I	VC-I	VC	R		S	S-I	R	R		
Nitella sp. (Stonewort)	I	R	V	R	R	R		S	S-I	R	R		
SUBMERGENT MACROPHYTES													
Sago pondweed (*P. pectinatus*)	I	C-I		VC				R	S	S	S		
Curly-leaf pondweed (*P. crispus*)	C	VC		VC				R	S	S	S		
Bass weed (*P. amplifolius*)	R	C		C				R	S-I	I			
Richardson pondweed (*P. richardsonii*)				VC-C				R	S-I	S-I	S		
Flat stemmed pondweed (*P. zosteriformis*)				C				R		S			
Other narrow-leaf pondweed (*Potamogeton sp.*)	I	C	C	VC-C				R	S	S	S		
Eurasian water milfoil (*Myriophyllum spicatum*)			VC					R	S	VS	VS		
Native milfoil (*M. exalbescens and others*)	C		C	VC				R	S	VS	VS		
Bladderwort (*Utricularia vulgaris*)		C		C				R	S	S-I			
Coontail (*Ceratophyllum demersum*)		C		VC				R	S-I	I	I		
Water Stargrass (*Heterantheria dubia*)				C				R		S-I			
Tape grass (*Vallisneria americana*)	R	I	C	VC	R	R	**MM	R	R	R	R	R	R
Water naiad (*Nojas flexilis*)		I		VC				R	S	S			
Canada water weed (*Elodea canadensis*)		C		VC				R	S-I	I	S-I		
EMERGENTS													
Cattails (*T. latifolia, T. angustifolia*)	VC	VC		VC	VC	I-C	M	R	R	R	R	I	S-I
Bulrush (*Scirpus spp.*)			C	VC	C	C	M	R					S-I
Sedge (*Carex sp.*)			C	C	C	VC	M	R					S-I
#Bur reed (*Sparganium spp.*)	C		C	C	C	VC	M	R					I
Water plantain (*Alisma spp.*)			I	C	C	VC		R					S
Pipewort (*Eriocaulon spp.*)	R	R	C	R	R	R	*M	R				S	
Arrowhead (*Sagittaria spp.*)		C		VC	I-C			R				S	
Pickerelweed (*Pontederia spp.*)			VC		I	R		R				S-I	
Water smartweed (*Polygonum amphibium*)	I	I						R				S-I	
Water shield (*Brasenia spp.*)			C					R				S-I	
White water lily (*Nymphaea spp.*)			C	C			*M	R			I	I	
Yellow water lily (*Nuphar spp.*)		C-I	C	C			*M	R			I	I	
Duckweed (*Lemna spp.*)	R	C	I-R	VC				R		S		S	
Duckmeal (*Wolffia spp.*)	R	C-I	I-R	VC				R		S		S	

VC — *Very common*
C — *Common*
I — *Infrequent*
R — *Rare*
#Bur reed is also very common as a submerged plant in ecotypes C and D.
**A typical Muskoka lake is an example of a soft water lake.*
***A typical Kawartha Lake is an example of a hard water lake.*
****A wet ditch generally contains under 80 to 90% of the year.*
*****A dry ditch generally contains water 50% or less of the year.*

1 *Cutrine Plus: Algimycin PLL-C*
2 *Simazine* (in enclosed pond systems only)
3 *Diquat*
4 *2,4-D granular*
5 *Paraquat*
6 *Amitrole, dalapon, glyphosate* (in dry ditches only)

S *Susceptible*
I *Intermediate*
R *Resistant*

M *Manual/mechanical methods equally as effective as herbicides.*
*M *Manual/mechanical methods generally more effective than herbicides.*
**MM *Manual/mechanical methods are the only control measure currently available.*

TABLE 8. CLASSIFICATION OF WEEDS ACCORDING TO RESPONSE TO VARIOUS FOLIAGE SPRAYS

Common Name	2,4-D	MCPA	MCPB	2,4-DB or Mecoprop	Dicamba
aster (P)	I				
bedstraw (P)	R	I-R	R	I	R
bellflower (P)	R				
bindweed, field (P)	I	I	I	I	S-I
blueweed (B)	S-I	I		I	I
bracken fern (P)	R	R	R	R	I
buckwheat, wild (A)	I-R	I	I-R	I-R	S
burdock (B)	S	S	I		S
buttercup (P)	I-R	S-I	I**(I-R)	I	I
campion, bladder (P)	R	R	R	R	
carrot, wild (B)	S-R	S-R	R	I-R	S
catchfly, night-flowering (A)	R	R	R	R	
catnip (P)	S-I				
chickweed, common (A)	I-R	I	R	S	S
chickweed, mouse-eared (P)	I-R	I-R	R	S	S
chicory (P)	S	S-I	S-I*(R)	I-R	S
cinquefoil, rough (WA)	I				
cinquefoil, sulfur (upright c.), (P)	I				
cocklebur (A)	S	S	S	S	S
cockle, purple (A)	I-R	R	R		I
cockle, white (P)	R		I-R		I
daisy, ox-eye (P)	I	I	R	I	I
dandelion (P)	S	S	I*(R)	I	S
dock (P)	I	I	I	I	
evening-primrose (B)	S				
false flax (WA)	S	S	S	S	S
fleabane, annual (daisy f.) (WA)	I	I	S-I		
fleabane, Canada (A)	S-I				
goat's-beard (B)	I				
goldenrod (P)	I	R	I	I	
goosefoot (A)	S	S	S	S	
goutweed (P)	R	R	R	R	
grasses (A and P)	R	R	R	R	
ground-ivy (creeping charlie) (P)	I-R	I-R		I	S
groundsel (A)	I	I			
hawkweed (P)	I-R	I-R			S-I
heal-all (P)	I-R	I-R	I-R	S	S
hemp-nettle (A)	R	S-I	I-R**(R)	R	
horse-nettle (P)	R				I
horsetail (P)	I-R	S-I	I-R	I-R	I
knapweeds (P)	R				I
knotweed (A)	I-R		I*(I-R)	S-I	S
Lady's-thumb (A)	S-I	I-R	I-R*(R)	I-R	S
lamb's-quarters (A)	S	S	S	S	S
lettuce, prickly (A)	S-I	S	S	S	
mallow, round-leaved (P)	I-R	I-R	I-R	I-R	
mayweed (A)	I-R		R		S
medick, black (WA)	I	I	I	S	I
milkweed (P)	R	R	R	I-R	I-R
motherwort (P)	S-I				

TABLE 8. CLASSIFICATION OF WEEDS ACCORDING TO RESPONSE TO VARIOUS FOLIAGE SPRAYS

Common Name	2,4-D	MCPA	MCPB	2,4-DB or Mecoprop	Dicamba
mullein (B)	I-R				
mustards (A)	S	S	I	S	
nightshade (P)	I-R			R	
parsnip, wild (B)	S				
pepper-grass, common (WA)	S	S-I	I		
pepper-grass, field (WA)	S	S	I		
pigweeds (A)	S	I	S-I	S	S
pineappleweed (A)	S		R	R	
plantains (P)	S	S	S-I	S-I	I
purslane (A)	I	I	S-I	S-I	
ragweed (A)	S	S	S	S	
ragwort	I-R	R	R	I	S-I
ribgrass (P) (see plantains)					
rocket, yellow (B)	S	I	I*(R)		
shepherd's-purse (WA)	S-I	S	S-I	S-I	
smartweed, green (A)	S-I	I-R	I-R	I-R	S
sorrel, sheep (P)	I	R			
sow-thistle, annual (A)	S	I	S-I	I	
sow-thistle, perennial (P)	I	R	S-I*(I-R)		S-I
speedwells (A and P)	I-R	I-R		S-I	S-I
spurge, cypress (P)	I-R	I-R	I-R		I
spurge, leafy (P)	I-R	I-R	I-R	R	I
spurry, corn (A)	R	I	R	I	S
St. John's-wort (P)	R	R	R	R	R
stinkweed (pennycress) (WA)	S	S	S-I	S	S
stonecrop, mossy (P)	I	I		S-I	
teasel (B)	I				
thistle, bull (B)	S	S	S	S	
thistle, Canada (P)	I	I	I	I	S-I
thistle, nodding (B)	I		I		
thistle, Russian (A)	S-I		I-R	R	S-I
toadflax (P)	R	R	R	R	
velvetleaf (A)	S-I	I	S-I*(I-R)		S-I
vetch (P)	I-R	I-R	R	I-R	I
vetches, wild (A)	S	S			
violet, field (field pansy) (A)	R			R	
water-hemlock (P)	S-I				
wood-sorrel (P)	I-R				
yarrow (P)	R	I-R		I-R	I-R

** 2,4-DB more effective (susceptibility to MCPB given in brackets)*
***MCPB more effective (susceptibility to 2,4-DB given in brackets)*

KEY:	Plant Classification		Response to Foliage Sprays
(A)	annual	S	**susceptible** i.e., killed by 1 application of 2,4-D, MCPA, or Mecoprop (1.2 kg or less per hectare); or by 1 application of Dicamba (425 g or less per hectare).
(WA)	winter annual	I	**intermediate** intermediate i.e., killed less rapidly but controlled, either by higher rates
(B)	biennial		or by repeated applications.
(P)	perennial	R	**resistant** i.e., not, or only slightly, damaged by chemical treatment. Control of this weed is not practical with herbicide(s) listed above this column.
		S-I	between susceptible and intermediate.
		I-R	between intermediate and resistant.

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Toronto	150 Bridgeland Ave. Suite 111 M6A 3A6	416-781-6118

PRECAUTIONS WITH PESTICIDES

1. Become familiar with the chemicals you are using. Keep a list of the common names in case of accidents or emergencies. This information can be found on the product labels and cross-referenced in this publication.
2. Always read the label before opening pesticide containers, and follow all precautions and directions.
3. Never smoke, chew tobacco or eat while handling or applying pesticides. DO NOT carry such items in clothes used for spraying.
4. Avoid inhaling spray droplets, dust or fumes.
5. Avoid spilling pesticides on skin or clothing.
6. Avoid contamination of water supplies, wells, ponds, streams etc. with pesticides when filling or flushing spray equipment. Never fill a sprayer directly from a stream, pond or well, unless the unit is equipped with an anti-backflow device to prevent siphoning.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove all contaminated clothing immediately, and wash contaminated skin thoroughly with soap and water. Wash clothing before reuse.
2. If clothing becomes wet with a pesticide when spraying, remove it immediately. When the spray operation is complete, remove contaminated clothes, have a bath or shower and put on freshly laundered clothing.
3. Clean up any pesticide spills immediately. Use dry soil or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice.
4. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to hospital immediately. Take the list of chemical common names with you and identify the ones being used. (See Emergency Procedures for Pesticide Poisoning.)
5. If a well becomes contaminated, follow clean-up instructions in OMAF Factsheet, Pesticide Contamination of Farm Water Supplies, Agdex 607.

SPECIAL INSTRUCTIONS

Storage

Keep pesticides out of the reach of children, irresponsible persons, pets, and livestock. Store pesticides in a room away from the home, food and feed, and keep the room locked. Post pesticide storage area notices. Where the storage facility is located in a flood plain, the chemicals should be stored above the highest water level.

Container Disposal

Unrinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful — why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!

Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing

device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute and results in a rinsed container. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

Paper and cardboard containers may be burned, provided that persons and animals are kept out of the smoke, and precautions are taken so that the smoke is not directed toward buildings, highways, roads, or outdoor areas frequented by the public.

PROTECTIVE CLOTHING WHEN USING PESTICIDES OUTDOORS

1. It is recommended that neoprene or rubber gloves, rubber boots, a protective apron or coverall and protective eye-shields be worn to reduce the risk of dermal exposure when measuring, mixing and loading herbicides.

   Protective clothing, including disposable gloves, aprons or overalls and hat covers, are available at reasonable prices from the major safety supply companies listed below.

2. Wash all clothing after use. Wear freshly laundered clothes each day.

3. Although recommended when loading and handling concentrates, the wearing of dual cartridge chemical respirators is neither mandatory nor required with all herbicides or under all conditions of herbicide use. If a label specifies respiratory protection, follow the directions closely. A wide range of respiratory devices for outdoor respiratory protection from certain pesticides is available from the major safety supply companies who offer both full and half-face models in varying sizes. Consult the safety supply company of your choice for appropriate guidance and selection.

Handy Metrics Conversion Factor

Litres per hectare x 0.4 = litres per acre
Kilograms per hectare x 0.4 = kilograms per acre

SAFETY SUPPLY COMPANIES IN ONTARIO PROVIDING PROTECTIVE CLOTHING AND/OR RESPIRATORY DEVICES FOR OUTDOOR PROTECTION AGAINST CERTAIN PESTICIDES

Respiratory Devices Manufactured By

American Optical

Available from: AOCO Limited, Subsidiary of American Optical Corporation, 60 Mobile Drive, Toronto, M4A 2R7, Tel. (416) 752-8780

Branches: Hamilton & Belleville.

H.S. Cover (York)

Available from: Levitt-Safety Ltd., 33 Laird Drive, Toronto, M4G 3S9, Tel. (416) 425-8700

Branches: Kitchener, London, Ottawa, St. Catharines, Sarnia, Stoney Creek, Sudbury and Thunder Bay.

Kasco Helmets

Available from: The St. George Co., St. George, N0E 1N0, Tel. (519) 442-2046

Mine Safety Appliances

Available from: MSA Canada Inc., 148 Norfinch Drive, North York, M3N 1X8, Tel. (416) 667-9400

3M Occupational Health & Safety Products Div.

Available from: Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), Ontario L4B 1E7, Tel. (416) 222-4111, (416) 222-2111

Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor.

North

Available from: Siebe-North Inc., 26 Dansk Court, Rexdale, M9W 5V8, Tel. (416) 675-2790

Respiratory Devices Manufactured By

Racal Airstream

Available from: Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), Ontario L4B 1E7, Tel. (416) 222-4111, (416) 222-2111

Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor.

Safety House

Available from: Safety House of Canada Ltd., 1275 Castlefield Ave., Toronto, M6B 1G4, Tel. (416) 789-0631

Branches: Kitchener, London, Orillia, Ottawa, St. Catharines & Stoney Creek.

Scott

Available from: Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), Ontario L4B 1E7, Tel. (416) 222-4111, (416) 222-2111

Survivair

Available from: Levitt-Safety Ltd., 33 Laird Drive, Toronto, M4G 3S9, Tel. (416) 425-8700

Branches: Kitchener, London, Ottawa, St. Catharines, Sarnia, Stoney Creek, Sudbury and Thunder Bay.

Willson

Available from: Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), Ontario L4B 1E7, Tel. (416) 222-4111, (416) 222-2111

Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor.

Many of the companies listed above have dealer outlets in addition to branch outlets. For details of dealer outlets contact the supply company of your choice.

METRIC INFORMATION

METRIC EQUIVALENTS

LENGTH	
inch	= 2.54 cm = 25.4 mm
foot	= 0.30 m
yard	= 0.91 m
mile	= 1.61 km
AREA	
square foot	= 0.09 m^2
square yard	= 0.84 m^2
acre	= 0.40 ha
VOLUME (dry)	
cubic yard	= 0.76 m^3
bushel	= 36.37 L
VOLUME (liquid)	
fluid ounce (Imp.)	= 28.41 mL
pint (Imp.)	= 0.57 L
gallon (Imp.)	= 4.55 L
gallon (U.S.)	= 3.79 L
WEIGHT	
ounce	= 28.35 g
pound	= 453.6 g
ton	= 0.91 tonne
PRESSURE	
pounds per square inch	= 6.90 kPa

THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m × 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight — Volume Equivalents (for water)

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Dry — Liquid Equivalents

1 cm^3 = mL
1 m^3 = 1000 L

APPLICATION RATE CONVERSIONS

(approximate)

Metric to Imperial (Approximate)

litres per hectare × 0.09	= gallons per acre
litres per hectare × 0.36	= quarts per acre
litres per hectare × 0.71	= pints per acre
millilitres per hectare × 0.015	= fluid ounces per acre
grams per hectare × 0.015	= ounces per acre
kilograms per hectare × 0.89	= pounds per acre
tonnes per hectare × 0.45	= tons per acre

Imperial to Metric (Approximate)

gallons per acre × 11.23	= litres per hectare (L/ha)
quarts per acre × 2.8	= litres per hectare (L/ha)
pints per acre × 1.4	= litres per hectare (L/ha)
fluid ounces per acre × 70	= millilitres per hectare (mL/ha)
tons per acre × 2.24	= tonnes per hectare (t/ha)
pounds per acre × 1.12	= kilograms per hectare (kg/ha)
ounces per acre × 70	= grams per hectare (g/ha)

Dry-Weight Equivalents

Grams or Kilograms per Hectare		Approximate Ounces or Pounds per Acre
100 grams	=	1½ ounces
200 grams	=	3 ounces
300 grams	=	4¼ ounces
500 grams	=	7 ounces
700 grams	=	10 ounces
1.10 kilograms	=	1 pound
1.50 kilograms	=	1¼ pounds
2.00 kilograms	=	1¾ pounds
2.50 kilograms	=	2¼ pounds
3.25 kilograms	=	3 pounds
4.00 kilograms	=	3½ pounds
5.00 kilograms	=	4½ pounds
6.00 kilograms	=	5¼ pounds
7.50 kilograms	=	6¾ pounds
9.00 kilograms	=	8 pounds
11.00 kilograms	=	10 pounds
13.00 kilograms	=	11½ pounds
15.00 kilograms	=	13½ pounds

Liquid Equivalents

Litres/Hectare		Approximate Gallons/Acre
50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

CONVERSION TABLES — METRIC TO IMPERIAL

Length

1 millimetre (mm)	= 0.04 inch
1 centimetre (cm)	= 0.40 inch
1 metre (m)	= 39.40 inches
1 metre (m)	= 3.28 feet
1 metre (m)	= 1.09 yards
1 kilometre	= 0.62 mile

Area

1 square centimetre (cm^2)	= 0.16 square inch
1 square metre (m^2)	= 10.77 square feet
1 square metre (m^2)	= 1.20 square yards
1 square kilometre (km^2)	= 0.39 square mile
1 hectare (ha)	= 107,636 square feet
1 hectare (ha)	= 2.5 acres

Volume (liquid)

1 millilitre (mL)	= 0.035 fluid ounce
1 litre (L)	= 1.76 pints
1 litre (L)	= 0.88 quart
1 litre (L)	= 0.22 gallon (Imperial)
1 litre (L)	= 0.26 gallon (U.S.)

Volume (dry)

1 cubic centimetre (cm^3)	= 0.061 cubic inch
1 cubic metre (m^3)	= 1.31 cubic yards
1 cubic metre (m^3)	= 35.31 cubic feet
1000 cubic metres (m^3)	= 0.81 acre-foot
1 hectolitre (hL)	= 2.8 bushels

Weight

1 gram (g)	= 0.035 ounce
1 kilogram (kg)	= 2.21 pounds
1 tonne (t)	= 1.10 short tons
1 tonne (t)	= 2205 pounds

Speed

1 metre per second	= 3.28 feet per second
1 metre per second	= 2.24 miles per hour
1 kilometre per hour	= 0.62 mile per hour

Pressure

1 kilopascal (kPa)	= 0.15 pounds/square inch

Temperature

°F = (°C × 9/5) + 32
°C = (°F-32) × 5/9

CONVERSION TABLES — IMPERIAL TO METRIC

Length

inch	= 2.54 cm
foot	= 0.30 m
yard	= 0.91 m
mile	= 1.61 km

Area

square foot	= 0.09 m^2
square yard	= 0.84 m^2
acre	= 0.40 ha

Weight

ounce	= 28.35 g
pound	= 453.6 g
ton	= 0.91 tonne

Volume (dry)

cubic yard	= 0.76 m^3
bushel	= 36.37 L

Volume (liquid)

fluid ounce (Imp.)	= 28.41 mL
pint (Imp.)	= 0.57 L
gallon (Imp.)	= 4.55 L
gallon (U.S.)	= 3.79 L

Pressure

pound per square inch	= 6.90 kPa

CHOOSE A CAREER WHERE THERE'S ALWAYS A PLACE TO FILL.

Ontario's Colleges of Agricultural Technology offer specialized two-year courses leading to a rewarding career in the food system.

One out of every five jobs in Ontario is connected to the food system, so your career possibilities there are almost endless. However, in many jobs you need some specialized education.

The colleges listed offer a wide variety of courses to give you the training that you need for careers ranging from Food Service Supervisor to Farming to Laboratory Technician. Give yourself a real advantage - call or write for more information:

Centralia College of Agricultural Technology, Huron Park, Ontario N0M 1Y0 Telephone: (519) 228-6691

Collège de technologie agricole et alimentaire d'Alfred, Alfred, Ontario K0B 1A0 Telephone: (613) 679-2218

Kemptville College of Agricultural Technology, Kemptville, Ontario K0G 1J0 Telephone: (613) 258-8335

New Liskeard College of Agricultural Technology, New Liskeard, Ontario Telephone: (705) 647-6738

Ridgetown College of Agricultural Technology, Ridgetown, Ontario N0P 2C0 Telephone: (519) 674-5456

University of Guelph, Guelph, Ontario N1G 2W1 Telephone (519) 824-4120

To receive a free copy of our informative booklet "Your career in the food system," just write to any of the colleges listed above.

Ministry of Agriculture and Food
ONTARIO

USE HERBICIDES SAFELY

1. **Follow directions!** Read the instructions and follow precautions printed on the container labels.
2. **Protect the eyes** and avoid inhaling chemicals or prolonged exposure of the skin to the chemical. Take special care when the herbicide is labeled "poisonous."
3. **Paraquat** — special care should be taken when handling paraquat (Gramoxone), especially the concentrate. Wear rubber or neoprene gloves, coveralls and eye shield. Prevent all contact with skin and eyes. Follow closely all precautions outlined on the product label. Do not apply through an air-blast sprayer.
4. **2,4-D and related chemicals** may seriously damage crops of grapes, tomatoes, turnips, tobacco, beans, carrots, sugar beets, fruit trees, ornamental plants, and many others.
   a. Spray only on **resistant** crops. Before commencing, survey the area for the presence of desirable plants that might be damaged by the herbicide. There is a definite risk involved when spraying 2,4-D within 400 metres of a susceptible crop. However, if care is taken, areas closer than this may be sprayed under favorable conditions.
   b. Spray on calm days or when there is a light breeze, away from the susceptible crop, and use as low a pressure as possible to reduce drift of the chemical. Use at least 100 L spray solution per hectare.
   c. Use an amine formulation whenever possible to reduce vapor drift.
   d. Use mechanical methods of weed and brush control where the spray risk is high.
   e. Use a special sprayer for herbicides such as 2,4-D. Such chemicals are almost impossible to remove from a sprayer and traces of them in other solutions may damage susceptible plants.
5. Mixtures of different herbicides, or mixtures of herbicides with foliar fertilizers, insecticides, or fungicides should not be applied to crops in a single application unless recommended on the label.
6. Do not store herbicides near fungicides, insecticides, fertilizers, or other agricultural chemicals.
7. Apply all herbicides properly, using the lowest recommended pressure.
8. **Avoid contamination of water supplies**, wells, ponds, streams, etc., when filling or flushing spray equipment, or when spraying. Never fill a sprayer directly from a well, pond or stream unless the unit is equipped with an anti-backflow device to prevent siphoning. Protect against spills.
9. **Rinse all empty metal or glass containers** three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute and results in a rinsed container. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

EMERGENCY PROCEDURE FOR PESTICIDE POISONING

Become familiar with the chemicals you are using. Keep a list of common names in case of accidents or emergencies. This information can be found on the product labels and cross-referenced in this publication.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water.

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL. TAKE THE LIST OF CHEMICAL COMMON NAMES WITH YOU AND IDENTIFY THE ONES BEING USED.

The Occupational Health and Safety Division, Ministry of Labour, 400 University Ave., Toronto, M5G 1S5, has physicians available for consultation on first-aid information and advice. They can be contacted in the following manner:

Between the hours of 8:00 a.m. and 5:00 p.m. Monday to Friday, telephone (416) 965-3610.

During weekends, public holidays and non-office hours, telephone (416) 965-1211 and ask for the "on-call" physician.

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